March 1979
Volume 23
Number 2

# Mariners Weather Log

National Oceanic and Atmospheric Administration • Environmental Data and Information Service

**U.S. DEPARTMENT OF COMMERCE**
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**NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION**
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**ENVIRONMENTAL DATA AND INFORMATION SERVICE.**
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Cover: The U.S. Coast Guard cutter ARUNDEL is wedged in ice off Rock Island in Lake Michigan. Her 20-man crew, linked together with ropes, walked 300 yd across the ice to the cutter ACACIA, which kept the ARUNDEL illuminated. The ACACIA was also stuck but managed to free herself and the ARUNDEL. See item on page 103. Wide World Photo.

**Mariners Weather Log**

**Editor: Elwyn E. Wilson**
**Editorial Assistant: Annette Farrall**

**March 1979**
**Volume 23 Number 2**
**Washington, D.C.**

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Routing
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Radio Officer _____

**PARTICIPATE IN AMVER**

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**The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical approved by the Director of the Office of Management and Budget through June 30, 1980.**

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Mariners Weather Log

# ANATOMY OF A STORM

Richard W. James
Liaison Office
U.S. Naval Oceanographic Office
Suitland, Md.

A major storm developed in the North Atlantic during September 9-12, 1978. One of the ships that felt the force and fury of this storm was the QUEEN ELIZABETH II, bound for New York from Europe. Early on September 11 the QUEEN ELIZABETH II encountered "very heavy southwest sea and swell with the wind gusting to force 12 (64 knots)" (figs. 1 and 2). Heavy seas caused damage to bow rails and bow plates; a deck platform was torn loose; and innumerable glasses, crockery, and dinnerware were broken (fig. 3). About a score of passengers and two crewmembers were injured, although none seriously.

What are the characteristics of such a storm? High winds and high seas, obviously, but more significant is

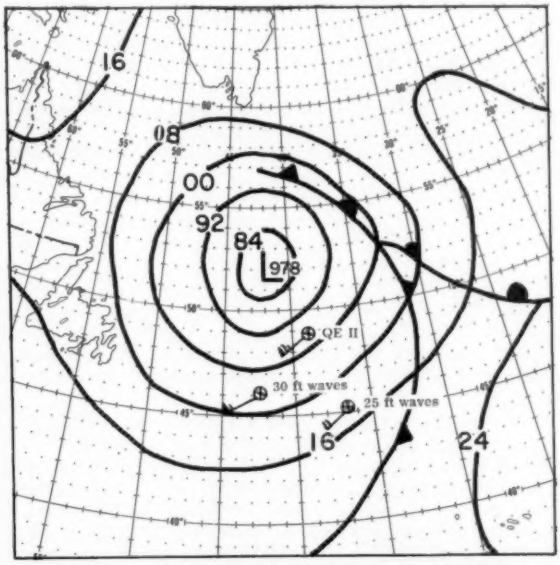


Figure 1.--The 1200 surface chart of September 11, 1978, shows the "Monster of the Month" near peak intensity as she batters the QUEEN ELIZABETH II.

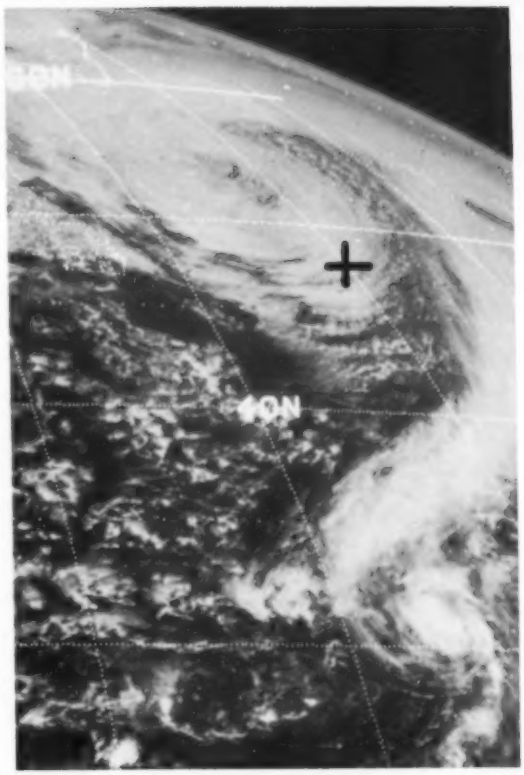


Figure 2.--The intensity of this storm is indicated by the tight cyclonic circulation. Near this time the QUEEN ELIZABETH II was fighting 39-ft waves. Earlier, they had exceeded 50 ft. The "+" marks her approximate position at 1700. Tropical storm Flossie is near 30°N, 45°W.

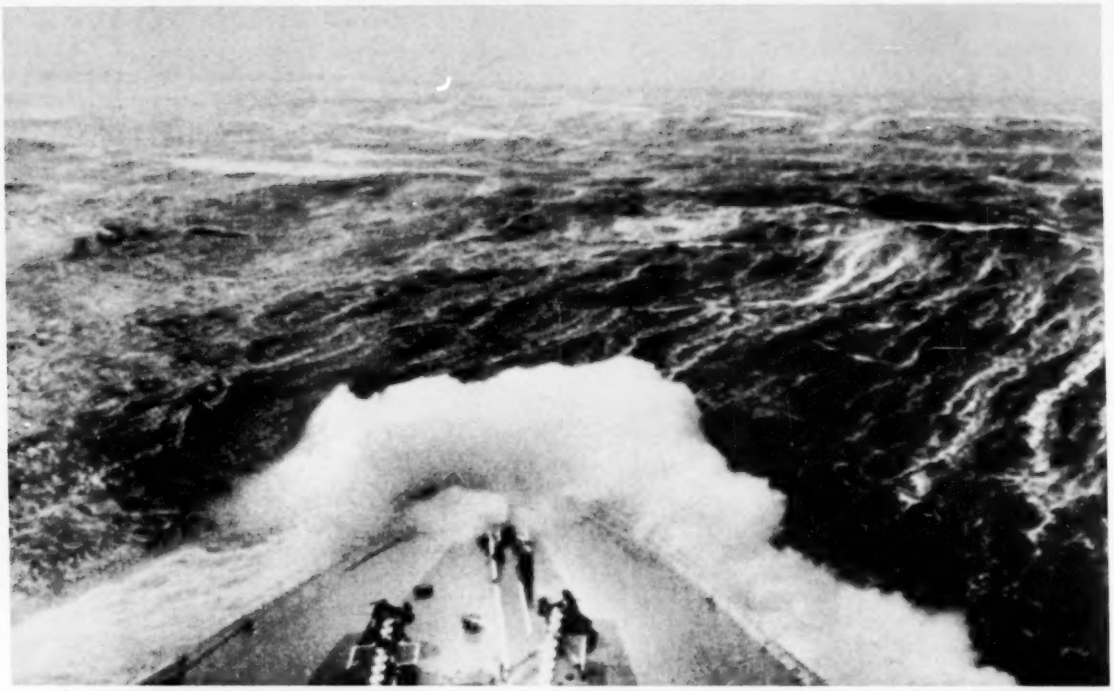

Figure 3.--Waves of up to 50 ft pound the QUEEN ELIZABETH II at the height of the storm on September 11. Wide World Photo.

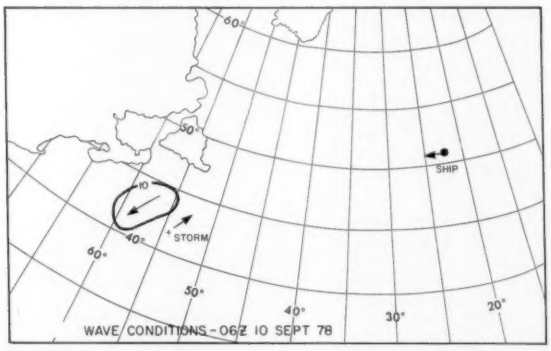


Figure 4.--Significant wave height analysis for 0600 September 10, 1978, with the location of QUEEN ELIZABETH II shown.

the rapidity with which the waves grow from merely bothersome to dangerous. Figures 4 through 8 illustrate this for the September storm.

Early on September 10 the storm was approximately 350 mi south of Newfoundland, having moved southeasterly from the coast of Maine during the previous 18 hr. Some deepening had occurred, but the only area in which waves over 10 ft had been generated was to the northwest of the LOW center. This was the result of a strong pressure gradient created by the movement of a high-pressure area into New England. At this time the QUEEN ELIZABETH II was some 1,400 mi to the east, steaming under light winds.

Some 12 hr later, at 1800 on September 10, the storm had moved to the northeast and had intensified considerably. As shown by figure 5, the region of 10-ft waves or higher had expanded tremendously, and 20-ft waves were present in the western portion of the storm. The QUEEN ELIZABETH II was still proceeding westward under light westerly winds and moderate swell.

Over the next 12 hr the storm became extremely dangerous as gale winds developed out to a distance of 500 mi from the center. Waves in excess of 30 ft had been generated near the center, and the area covered by waves of 10 ft or greater had grown from the 180 by 300 mi box 24 hr earlier to a circular region roughly 500 mi in diameter straddling the northern shipping lanes. In other words, the storm area had not just doubled or tripled, but it had expanded by 1,600 percent in just 24 hr.

Figure 6 shows the wave conditions and QUEEN ELIZABETH II's position at 0600 on September 11. The ship was well into the storm and, although not in the most dangerous quadrant, reported "rough beam seas and heavy swell." Power had been reduced to ease the pitching. Two hours later the QUEEN ELIZABETH II changed to a southerly course and reduced speed even further. She reported "pitching and pounding heavily, at times taking water forward and heavy spray overall. Wind gusting to force 12. Very heavy

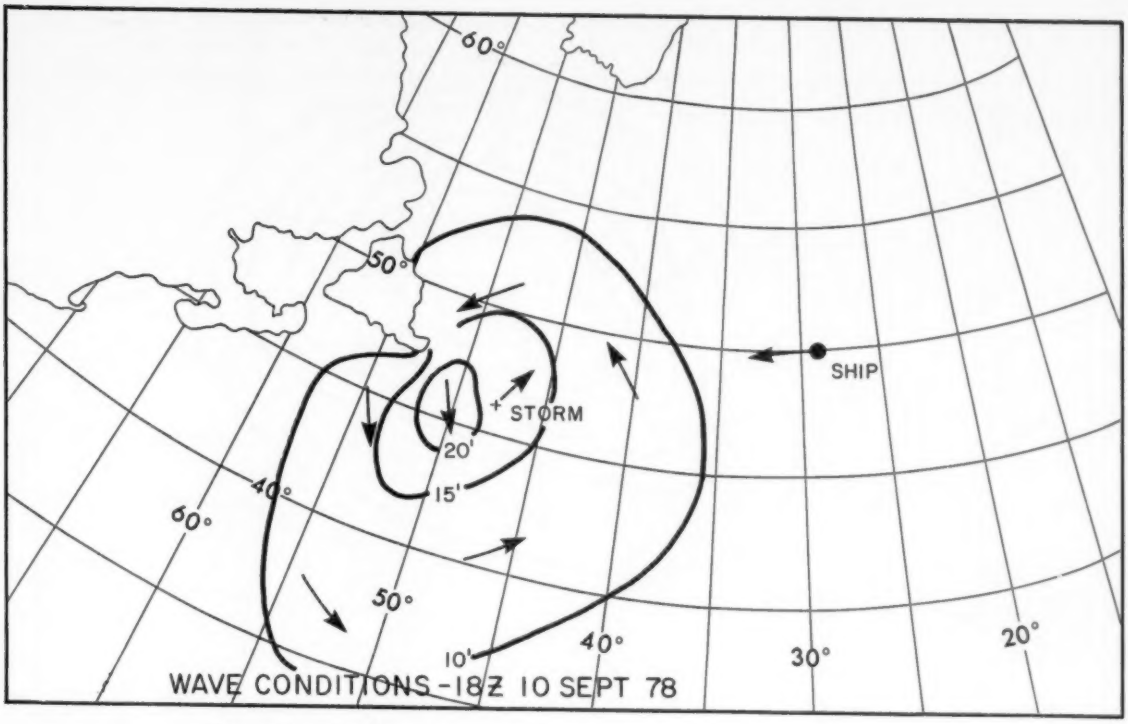


Figure 5.--Significant wave height analysis for 1800 September 10, 1978.

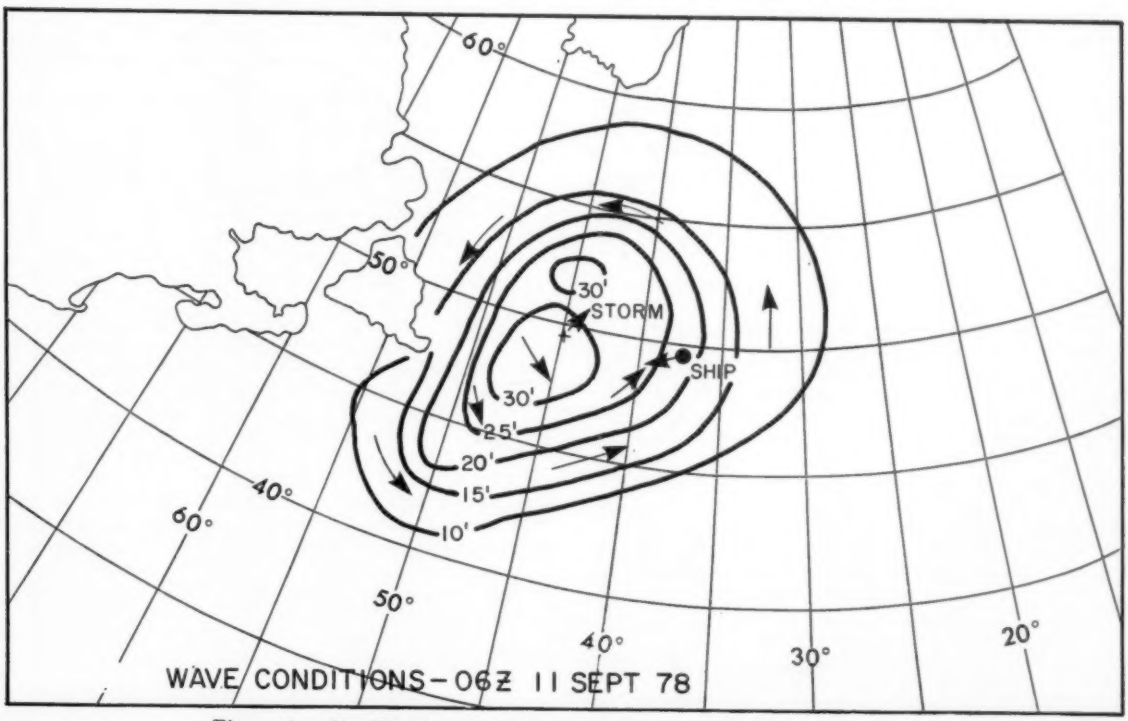


Figure 6.--Significant wave height analysis for 0600 September 11, 1978.

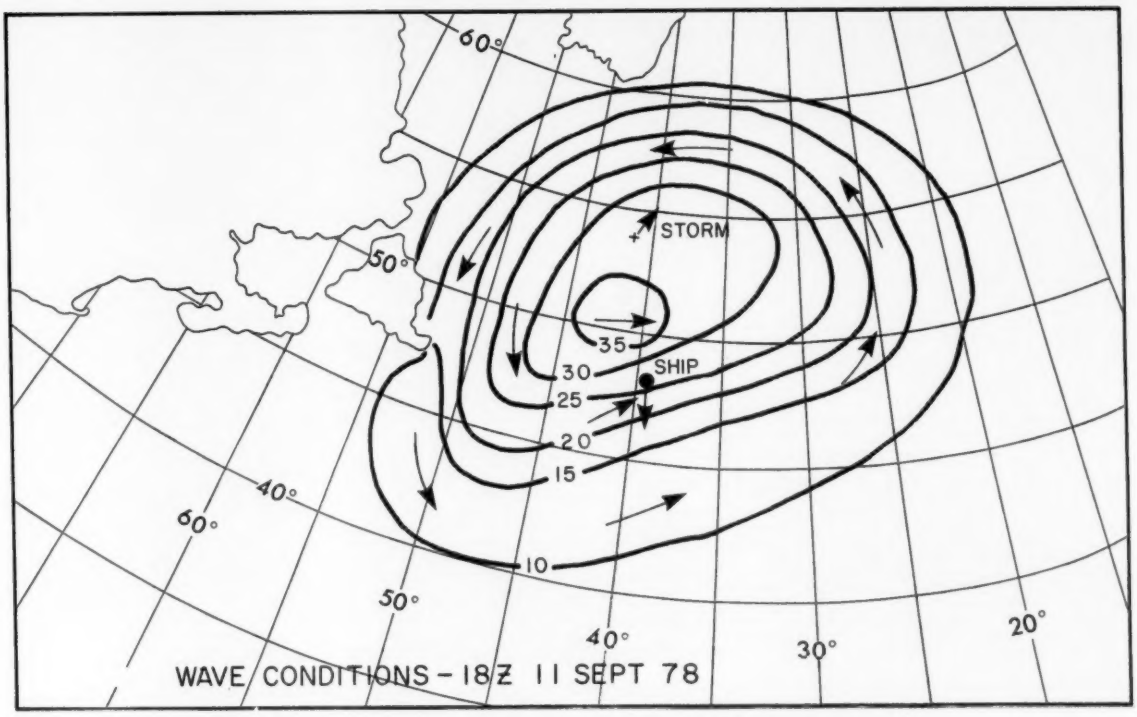


Figure 7.--Significant wave height analysis for 1800 September 11, 1978.

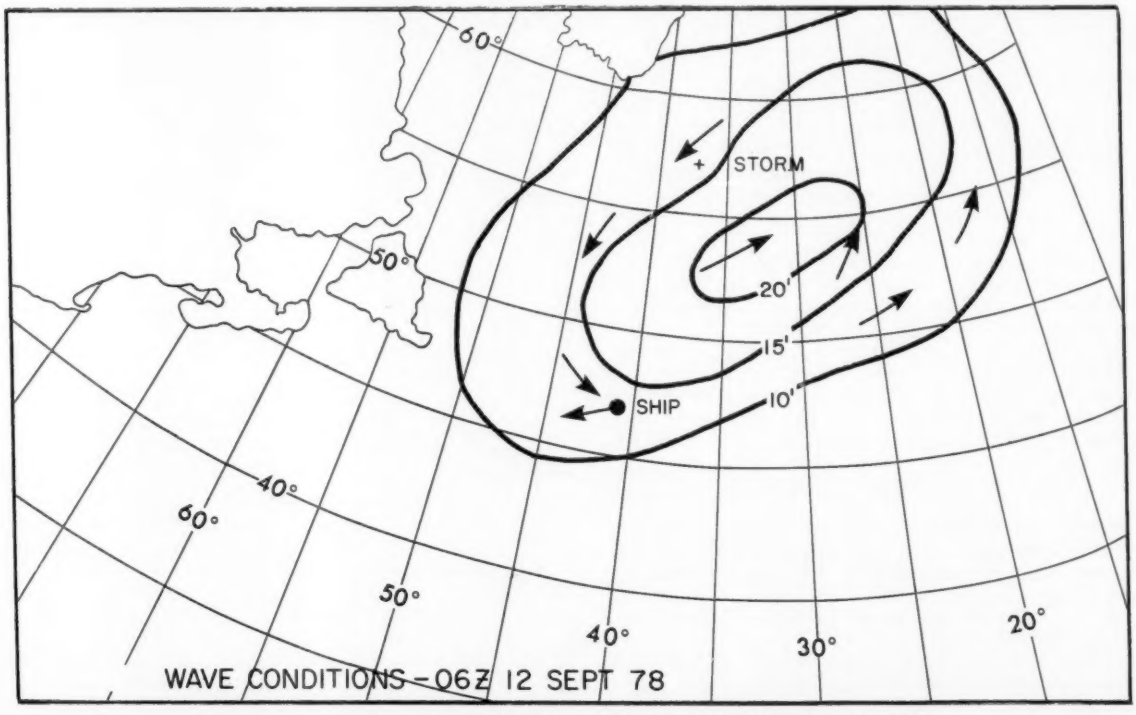


Figure 8.--Significant wave height analysis for 0600 September 12, 1978.

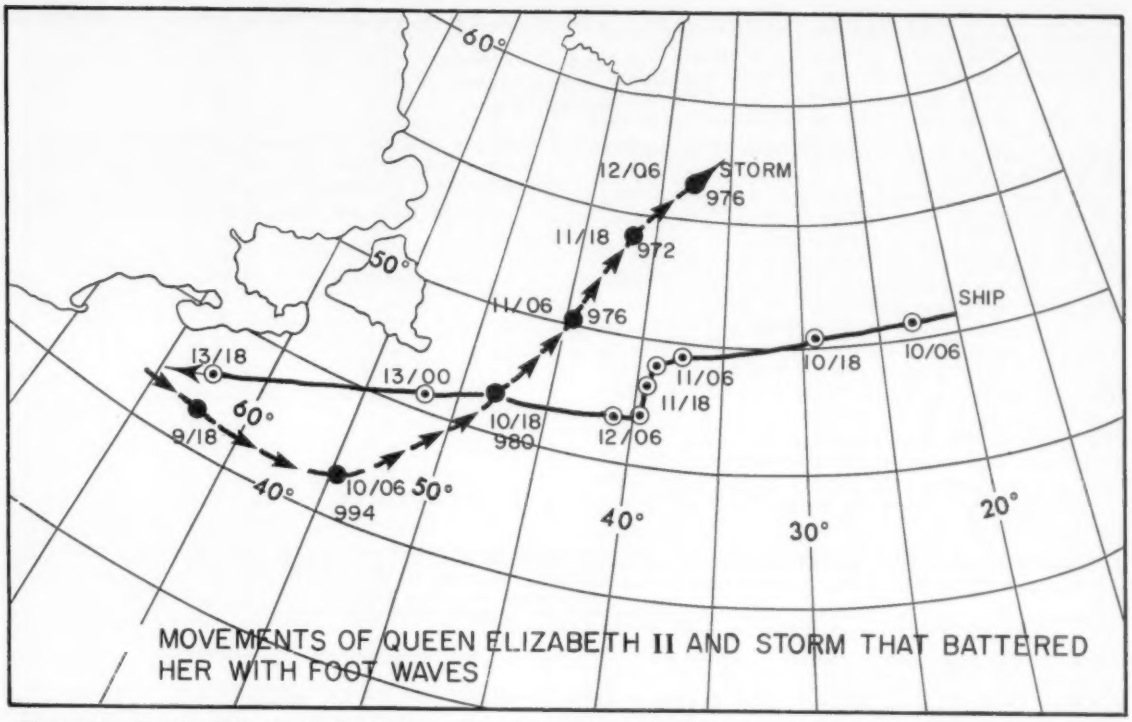


Figure 9.--Track of the severe September storm in relation to the QUEEN ELIZABETH II. Note the diversion to the south that avoided the extreme waves.

southwest swell and very rough seas." During this period the ship's barometer bottomed at 991 mb--it had dropped 27 mb in 12 hr.

Her change in course was a good maneuver as the storm continued to intensify (fig. 7). On her original westward course the QUEEN ELIZABETH II would have encountered increasingly rough seas of 30 to 35 ft, instead of 20 to 25 ft. Instead, as shown by figure 7, the ship and storm were now moving in opposite directions. Although the situation was still dangerous at 1800 on September 11, the QUEEN ELIZABETH II was headed for more moderate conditions.

The final wave analysis (fig. 8) shows that by 0600 on September 12 the ship was back on course with moderating conditions. Waves were still over 10 ft with northwesterly 30-kn winds, but the worst was over. Although still dangerous, the storm was weakening.

How high were the maximum waves encountered by the QUEEN ELIZABETH II? As shown by the analyses of figures 6 and 7, the "significant" wave heights were on the order of 25 ft. This figure is consistent with the ship's reports. A significant wave, however, is defined as the average height that a mariner sees when visually estimating the size of waves in a seaway. This is necessary since in a storm there is a large variation in individual heights; a fact reflected in the common adage "every third wave is the largest" (or every fifth, seventh, and so on).

Studies show that in a seaway where the significant wave height is 25 ft, a number of waves will reach heights of 30 to 35 ft and at least once every 3 hr an exceptional wave of double the size of the significant waves can occur. Thus, a single wave of 50 ft was possible during the time the QUEEN ELIZABETH II was closest to the storm's center. Closer to the center of the storm, where the significant heights were 30 to 35 ft, the maximum wave could have been as high as 70 ft.

Figure 9 shows the overall tracks of the storm and the QUEEN ELIZABETH II. The diversion to the south, which resulted in a later arrival in New York, was nevertheless worthwhile considering the potential risk of adhering to the original track.

Mariners Weather Log

# NORTH ATLANTIC TROPICAL CYCLONES, 1978

Miles B. Lawrence
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There were 11 named tropical cyclones during the 1978 hurricane season, 5 of which reached hurricane force. In addition, there was one subtropical storm in January 1978, whose claim to fame is that it was the first tropical or subtropical storm to form in this month (records are available back through 1871). Figure 10 shows this season's storm tracks, and table 1 summarizes the data for these storms.

This year's activity (11 named storms and 1 subtropical system) is just above the long-term average of 10 storms, 6 of which are hurricanes. However, the total number of storms is somewhat offset this year by the short duration of the individual cyclones. To illustrate, the total number of hurricane hours (each hour that a storm has windspeeds greater than 63 kn) computed for 1978 was 307 compared to a 30-yr average of 620 hurricane hours. With reference to effects on maritime operations, loss of life, and property damage, the number of hurricane hours is more relevant than the total number of storms. Tables 2 and 3 summarize past years' data.

Table 4 lists the ships that reported gale-force

Table 1.--Summary of North Atlantic tropical- and subtropical-cyclone statistics, 1978

| No. | Name | Class | Dates | Maximum sustained wind(kn) | Lowest pressure (mb) | U.S. damage ($ million) | Deaths |
|---|---|---|---|---|---|---|---|
| --- | --- | ST | Jan. 18-22 | 40 | 1002 | | |
| 1 | Amelia | T | July 30-31 | 45 | 1005 | 20 | 33 |
| 2 | Bess | T | Aug. 5-8 | 45 | 1005 | | |
| 3 | Cora | H | Aug. 7-11 | 80 | 980 | | |
| 4 | Debra | T | Aug. 26-29 | 50 | 1000 | | 2 |
| 5 | Ella | H | Aug. 29-Sept. 5 | 120 | 956 | | |
| 6 | Flossie | H | Sept. 3-16 | 85 | 976 | | |
| 7 | Greta | H | Sept. 13-20 | 115 | 947 | | 5(Honduras, Belize) |
| 8 | Hope | T | Sept. 11-21 | 55 | 987 | | |
| 9 | Irma | T | Oct. 2-5 | 45 | 1001 | | |
| 10 | Juliet | T | Oct. 7-11 | 45 | 1006 | | |
| 11 | Kendra | H | Oct. 28-Nov. 3 | 70 | 990 | minor (Puerto Rico) | 1 |

ST - subtropical storm (winds 34 kn or higher)
T - tropical storm (winds 34 - 63 kn)
H - hurricane (winds 64 kn or higher)

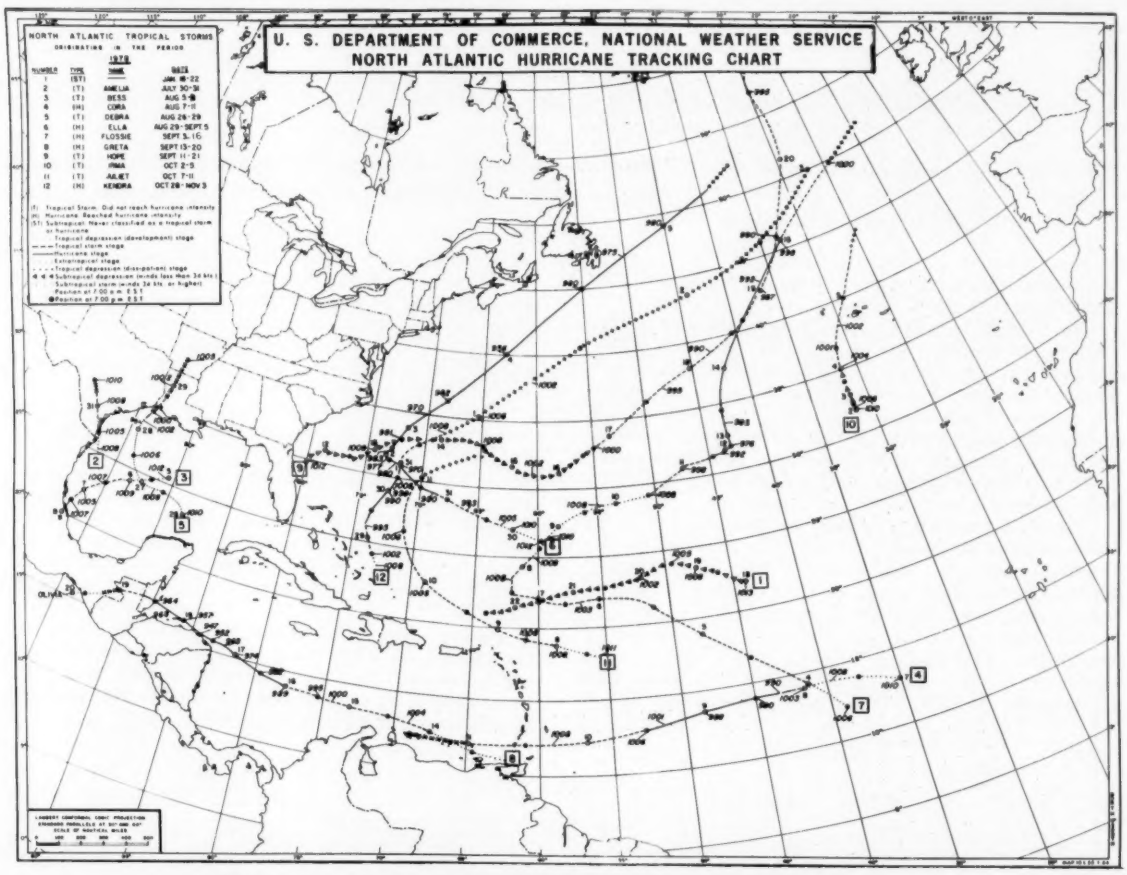

U. S. DEPARTMENT OF COMMERCE, NATIONAL WEATHER SERVICE
NORTH ATLANTIC HURRICANE TRACKING CHART
NORTH ATLANTIC TROPICAL STORMS ORIGINATING IN THE PERIOD 1978
NUMBER TYPE NAME DATES
1 (ST) JAN. 18-22
2 (T) AMELIA JULY 30-31
3 (T) BESS AUG 5-8
4 (H) CORA AUG 7-11
5 (T) DEBRA AUG 26-29
6 (H) ELLA AUG 29-SEPT 5
7 (H) FLOSSIE SEPT 3-16
8 (H) GRETA SEPT 13-20
9 (T) HOPE SEPT 11-21
10 (T) IRMA OCT 2-5
11 (T) JULIET OCT 7-11
12 (H) KENDRA OCT 28-NOV 3
OLIVER

Figure 10.--Tracks of North Atlantic tropical cyclones, 1978.

**Table 2**
**NORTH ATLANTIC TROPICAL CYCLONES FOR PAST YEARS**

| Year | Total Number Tropical Cyclones* | | Total Number Hurricanes | | Loss of Life | | Damage in Categories** | |
|---|---|---|---|---|---|---|---|---|
| | All Areas | Reaching U.S. Coast | All Areas | Reaching U.S. Coast | Total All Areas | United States | Total All Areas | United States |
| 1931 | 9 | 2 | 2 | 0 | | 0 | | x |
| 1932 | 11 | 5 | 6 | 2 | | 0 | | x |
| 1933 | 21 | 7 | 9 | 5 | | 63 | | 7 |
| 1934 | 11 | 5 | 6 | 3 | | 17 | | 6 |
| 1935 | 6 | 2 | 5 | 2 | | 114 | | 7 |
| | 58 | 21 | 28 | 12 | | | | |
| 1936 | 16 | 7 | 7 | 3 | | 8 | | 6 |
| 1937 | 9 | 4 | 3 | 0 | | 0 | | 4 |
| 1938 | 8 | 4 | 5 | 2 | | 600 | | 6 |
| 1939 | 5 | 3 | 3 | 1 | | 3 | | 5 |
| 1940 | x | 3 | 4 | 2 | | 51 | | 6 |
| | 46 | 21 | 20 | x | | | | |
| 1941 | 6 | x | 4 | 2 | | 10 | | 7 |
| 1942 | 10 | 5 | 4 | 2 | 17 | x | 7 | 7 |
| 1943 | 10 | 4 | 3 | 1 | 19 | 16 | 7 | 7 |
| 1944 | 11 | 4 | 7 | 3 | 1,076 | 64 | x | x |
| 1945 | 11 | 5 | 5 | 3 | 29 | 7 | x | x |
| | 48 | 20 | 25 | 11 | | | | |
| 1946 | 6 | 1 | 3 | 1 | 3 | 0 | 7 | 7 |
| 1947 | 9 | 7 | 3 | 0 | 72 | 33 | x | x |
| 1948 | 9 | 4 | 6 | 3 | 24 | 3 | 7 | 7 |
| 1949 | 13 | 6 | 7 | 2 | 1 | 1 | x | x |
| 1950 | 13 | 4 | 11 | 3 | 27 | 19 | 7 | 7 |
| | 50 | 22 | 32 | 12 | | | | |
| 1951 | 10 | 1 | x | 0 | 244 | 0 | 7 | 6 |
| 1952 | 7 | 2 | 6 | 1 | 10 | 3 | 6 | 6 |
| 1953 | 14 | 6 | 6 | 2 | 8 | 2 | 7 | 7 |
| 1954 | 11 | 4 | x | 3 | 720 | 185 | x | x |
| 1955 | 12 | 3 | 9 | 3 | 1,510 | 210 | x | x |
| | 54 | 16 | 37 | x | | | | |
| 1956 | x | 2 | 4 | 1 | 76 | 21 | x | 7 |
| 1957 | x | 0 | 3 | 1 | 474 | 390 | x | x |
| 1958 | 10 | 1 | 7 | 0 | 49 | 7 | 7 | 7 |
| 1959 | 11 | 7 | 7 | 3 | 57 | 24 | 7 | 7 |
| 1960 | 7 | 4 | 4 | 2 | 193 | 63 | x | x |
| | 44 | 20 | 25 | 7 | | | | |
| 1961 | 11 | x | x | 1 | 340 | 46 | x | x |
| 1962 | 5 | 1 | 3 | 0 | 4 | 4 | x | 6 |
| 1963 | 9 | 1 | 7 | 1 | 7,215 | 11 | x | 7 |
| 1964 | 12 | 6 | 6 | 1 | 200 | 49 | x | x |
| 1965 | x | x | 4 | 1 | 76 | 75 | x | x |
| | 43 | 15 | 29 | 7 | | | | |
| 1966 | 11 | 2 | 7 | 2 | 1,040 | 54 | x | 7 |
| 1967 | x | 2 | x | 1 | 66 | 16 | x | x |
| 1968 | 8 | 3 | 5 | 1 | 11 | 9 | 7 | 7 |
| 1969 | 18 | 3 | 12 | 2 | 364 | 256 | x | x |
| 1970 | 10 | 3 | 5 | 1 | 74 | 13 | x | x |
| | 55 | 13 | 35 | 7 | | | | |
| 1971 | 13 | 5 | 6 | 3 | 44 | x | x | x |
| 1972 | 7 | 3 | 3 | 1 | 128 | 121 | x | x |
| 1973 | 6 | 1 | 4 | 0 | 16 | 5 | 7 | 7 |
| 1974 | 11 | 2 | 4 | 1 | 3,000- | 1 | x | x |
| 1975 | 9 | 1 | 6 | 1 | 60 | 24 | x | x |
| | 48 | 12 | 23 | x | | | | |
| 1976 | 6 | 4 | 6 | 1 | 77 | 2 | x | x |
| 1977 | 6 | 1 | 5 | 3 | 16 | 0 | 7 | 7 |
| 1978* | 12 | 2 | 5 | 0 | 41 | 33 | 7 | 7 |
| Total | 477 | 167 | 269 | 81 | | | | |
| Mean | 9.5 | 3.3 | 5.6 | 1.7 | | | | |

**The Environmental Data Service has for some time recognized that, without detailed expert appraisal of damage, all figures published are merely approximations. Since errors in dollar estimates vary in proportion of the total damage, storms are placed in categories varying from 1 to 9 as follows:

| | | |
|---|---|---|
| 1 Less than $50 | 4 $5,000 to $50,000 | 7 $5,000,000 to $50,000,000 |
| 2 $50 to $500 | 5 $50,000 to $500,000 | 8 $50,000,000 to $500,000,000 |
| 3 $500 to $5,000 | 6 $500,000 to $5,000,000 | 9 $500,000,000 to $5,000,000,000 |

*Including hurricanes
x Not reported in literature, believed minor.
- Additional deaths for which figures are not available.

winds or higher, low pressures, or unusual sea conditions in association with a tropical weather system. There are 97 ships in the table this year. In 1976, for example, with only eight named storms, there were 151 ships included in the table for the year--33 percent less storms, but 50 percent more ships. This situation is clarified by adding that there were 596 hurricane hours in 1976; i.e., the hurricanes were of longer duration, on the average, that year.

Note that there were no ships reporting gales during tropical storms Amelia and Bess. These were both short-lived weak storms in the western Gulf of Mexico. On the other hand, tropical storm Debra, also in the western Gulf of Mexico, is represented by 12 reports of 34-kn winds or higher.

Cora reached hurricane force in the tropical Atlantic, midway between Africa and the Caribbean Sea. This is an area to the south of the primary shipping lanes, and the National Hurricane Center received no ship reports of gale-force winds or higher during this storm. This is an appropriate time to remind our readers that timely ship reports play an important role in the monitoring and prediction of dangerous storms at sea.

There were two memorable events in connection with landfall storms. The remnants of Amelia produced excessive rainfall over central Texas, and hurricane Greta blasted the sparsely populated northeast coast of Honduras in Central America with 115-kn sustained winds.

The sections that follow contain accounts of the individual storms. These accounts were extracted from preliminary storm reports compiled at the National Hurricane Center. Detailed meteorological information will be published in the annual review article in the April issue of Monthly Weather Review.

**Table 3**
**NORTH ATLANTIC TROPICAL CYCLONES FOR PAST YEARS**

Frequency of Tropical Cyclones (including Hurricanes) by Months and Years

| | | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1931 | | | 1 | 1 | 2 | 2 | 1 | 1 | | 9 |
| 1932 | | 1 | | | 2 | 5 | 3 | 1 | | 11 |
| 1933 | | 1 | 1 | 3 | 7 | 5 | 3 | 1 | | 21 |
| 1934 | | 1 | 1 | 1 | 2 | 2 | 3 | 1 | | 11 |
| 1935 | | | | | 3 | 1 | 2 | | | 6 |
| | | | | | | | | | | 58 |
| 1936 | | | 3 | 2 | 6 | 4 | 1 | | | 16 |
| 1937 | | | | 1 | 2 | 6 | | | | 9 |
| 1938 | | | | | 3 | 1 | 3 | 1 | | 8 |
| 1939 | | | 1 | | 1 | 1 | 2 | | | 5 |
| 1940 | | 1 | | | 3 | 2 | 2 | | | 8 |
| | | | | | | | | | | 46 |
| 1941 | | | | | | 4 | 2 | | | 6 |
| 1942 | | | | | 3 | 3 | 3 | 1 | | 10 |
| 1943 | | | | 1 | 2 | 4 | 3 | | | 10 |
| 1944 | | | | 3 | 3 | 4 | 3 | | | 11 |
| 1945 | | | 1 | 1 | 4 | 3 | 2 | | | 11 |
| | | | | | | | | | | 48 |
| 1946 | | | 1 | 1 | 1 | 1 | 2 | | | 6 |
| 1947 | | | | 1 | 3 | 3 | 2 | | | 9 |
| 1948 | | 1 | | | 3 | 3 | 1 | 1 | | 9 |
| 1949 | | | | | 3 | 3 | 3 | | 1 | 10 |
| 1950 | | | | | 4 | 3 | 6 | | | 13 |
| | | | | | | | | | | 50 |
| 1951 | | 1 | | | 3 | 4 | 2 | | | 10 |
| 1952 | (Feb.) 1 | | | | 3 | 2 | 2 | | | 7 |
| 1953 | | 1 | | | 3 | 4 | 4 | 1 | 1 | 14 |
| 1954 | | | 1 | 1 | 2 | 4 | 1 | 1 | 1 | 11 |
| 1955 | | | | 1 | 4 | 5 | 2 | | | 12 |
| | | | | | | | | | | 54 |
| 1956 | | | 1 | 1 | 1 | 4 | 1 | | | 8 |
| 1957 | | | 2 | | 1 | 4 | 1 | | | 8 |
| 1958 | | | 1 | | 4 | 4 | 1 | | | 10 |
| 1959 | | 1 | 2 | 2 | 1 | 3 | 2 | | | 11 |
| 1960 | | | 1 | 2 | 1 | 3 | | | | 7 |
| | | | | | | | | | | 44 |
| 1961 | | | | 1 | 3 | 6 | 2 | 2 | | 11 |
| 1962 | | | | | | 2 | 1 | | | 5 |
| 1963 | | | | 1 | 1 | 5 | 2 | | | 9 |
| 1964 | | | 1 | 1 | 4 | 4 | 1 | 1 | | 12 |
| 1965 | | | 1 | | 2 | 2 | 1 | | | 6 |
| | | | | | | | | | | 43 |
| 1966 | | | 1 | 4 | 1 | 4 | | 1 | | 11 |
| 1967 | | | | | 3 | 1 | 2 | | | 6 |
| 1968 | | | | 2 | | 3 | 1 | | | 6 |
| 1969 | | | | | 1 | 2 | 2 | 1 | | 6 |
| 1970 | | | 1 | | 1 | 3 | 2 | | | 7 |
| | | | | | | | | | | 36 |
| 1971 | | | | 1 | 4 | 6 | 1 | 1 | | 13 |
| 1972 | | 1 | 1 | | 2 | 2 | 1 | | | 7 |
| 1973 | | | | 2 | 2 | 2 | 2 | | | 8 |
| 1974 | | | 1 | 1 | 4 | 4 | 1 | | | 11 |
| 1975 | | | 1 | 1 | 2 | 2 | 1 | | 1 | 8 |
| | | | | | | | | | | 47 |
| 1976 | | 1 | | 1 | 0 | 2 | 1 | | | 5 |
| 1977 | | | | | 1 | 3 | 2 | | | 6 |
| 1978 | (Jan) 1 | | | 1 | 4 | 3 | 3 | | | 12 |
| Totals | (Jan) 1 (Feb) 1 | 11 | 26 | 39 | 124 | 164 | 91 | 17 | 3 | 477 |

Frequency of Tropical Cyclones Reaching Hurricane Intensity by Months and Years

| | | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1931 | | | | | | 2 | | | | 2 |
| 1932 | | | | | 2 | 2 | 1 | 1 | | 6 |
| 1933 | | | | 1 | 2 | 2 | 1 | | | 6 |
| 1934 | | | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 1935 | | | | | 2 | 1 | 2 | | | 5 |
| | | | | | | | | | | 25 |
| 1936 | | | 1 | 1 | 2 | 2 | | | | 7 |
| 1937 | | | | | | 2 | | | | 2 |
| 1938 | | | | | 2 | 1 | | | | 3 |
| 1939 | | | | | 1 | | 2 | | | 3 |
| 1940 | | | | | 3 | 1 | | | | 4 |
| | | | | | | | | | | 19 |
| 1941 | | | | | | 3 | 1 | 1 | | 5 |
| 1942 | | | | | 3 | 1 | | | | 4 |
| 1943 | | | | 1 | 2 | 1 | 1 | | | 5 |
| 1944 | | | | 2 | 1 | 2 | 1 | | | 6 |
| 1945 | | | 1 | | 1 | 1 | 2 | | | 5 |
| | | | | | | | | | | 30 |
| 1946 | | | | 1 | | 1 | 1 | | | 3 |
| 1947 | | | | | 2 | 1 | 2 | 1 | | 6 |
| 1948 | | | | | 2 | 3 | 1 | | 1 | 7 |
| 1949 | | | | | 3 | 4 | 4 | | | 11 |
| 1950 | | | | | 4 | 3 | 4 | | | 11 |
| | | | | | | | | | | 34 |
| 1951 | 1 | | | | 2 | 2 | 2 | | | 6 |
| 1952 | | | | | 2 | 2 | 2 | | | 6 |
| 1953 | | | | | 2 | 3 | 1 | | 1 | 7 |
| 1954 | | | 1 | | 2 | 3 | 1 | | | 8 |
| 1955 | | | | | 3 | 5 | 1 | | | 9 |
| | | | | | | | | | | 36 |
| 1956 | | | | 1 | 1 | 1 | 1 | | | 4 |
| 1957 | | | 1 | | | 1 | 2 | | | 4 |
| 1958 | | | | | 2 | 3 | 2 | | | 7 |
| 1959 | | | 1 | 2 | | 3 | 1 | | | 7 |
| 1960 | | | | 1 | 1 | 2 | | | | 4 |
| | | | | | | | | | | 26 |
| 1961 | | | | 1 | | 5 | 1 | 1 | | 8 |
| 1962 | | | | | 1 | 1 | 1 | | | 3 |
| 1963 | | | | 1 | 3 | 4 | 1 | | | 9 |
| 1964 | | | | | 2 | 3 | 1 | | | 6 |
| 1965 | | | | | 3 | 1 | 1 | | | 4 |
| | | | | | | | | | | 30 |
| 1966 | | | 1 | 2 | 1 | 1 | | 2 | | 7 |
| 1967 | | | | | 1 | 3 | 2 | | | 6 |
| 1968 | | | | 2 | 1 | 3 | 1 | | | 7 |
| 1969 | | | 1 | | 1 | 3 | 2 | | | 7 |
| 1970 | | 1 | | | 1 | 1 | | | | 3 |
| | | | | | | | | | | 30 |
| 1971 | | | | 1 | 2 | 4 | | | | 7 |
| 1972 | | | 1 | | 1 | 1 | 1 | | | 4 |
| 1973 | | | | 1 | 1 | 1 | | | | 3 |
| 1974 | | | | | 2 | 2 | | | | 4 |
| 1975 | | | | 1 | 2 | 3 | | | | 6 |
| | | | | | | | | | | 24 |
| 1976 | | | | | 4 | 1 | 1 | | | 6 |
| 1977 | | | | | 1 | 3 | 1 | | | 5 |
| 1978 | | | | | 2 | 2 | 1 | | | 5 |
| Totals | | 2 | 11 | 18 | 76 | 104 | 46 | 7 | 1 | 269 |

Table 4.--Ships encountering tropical cyclones in the North Atlantic during 1978

| Vessel | Nationality | Date | Position of Ship | | Time GMT | Wind | | Visibility n. mi. | Present Weather code | Pressure mb. | Temperature °C | | Sea Waves+ | | Swell Waves | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lat. deg. | Long. deg. | | Dir. 10° | Speed kt. | | | | Air | Sea | Period sec. | Height ft. | Dir. 10° | Period sec. | Height ft. |
| SUBTROPICAL STORM | | JAN | | | | | | | | | | | | | | | |
| SMIT HOUSTON | NETHERLANDS | 19 | 24.0 | 49.9 | 06 | 03 | 35 | | | 1014.0 | | | | | | | |
| HOEGH MARLIN | NORWAY | 19 | 25.5 | 50.4 | 12 | 04 | 35 | | | 1016.4 | | | 07 | 10 | 04 | 09 | 11 |
| KRAGUJEVAC | YUGOSLAVIA | 19 | 23.6 | 45.9 | 12 | 15 | 45 | | | 1015.0 | | | 06 | 08 | | | |
| HOEGH MARLIN | NORWAY | 19 | 25.8 | 49.3 | 18 | 05 | 35 | | | 1017.5 | | | 09 | 11 | 04 | 09 | 16 |
| KRAGUJEVAC | YUGOSLAVIA | 19 | 24.2 | 45.0 | 18 | 15 | 45 | | | 1019.5 | | | 08 | 08 | | | |
| SMIT HOUSTON | NETHERLANDS | 20 | 24.3 | 48.1 | 00 | 13 | 35 | | | 1011.0 | | | | | | | |
| HOEGH MARLIN | NORWAY | 20 | 26.0 | 49.0 | 00 | 06 | 40 | | | 1015.2 | | | 09 | 11 | 06 | 09 | 16 |
| DEGAS | FRANCE | 20 | 27.0 | 52.5 | 00 | 05 | 35 | | | 1019.5 | | | 05 | 10 | 07 | 09 | 23 |
| POINTE LA RUSE | FRANCE | 20 | 23.5 | 52.1 | 18 | 14 | 40 | | | 1012.0 | | | 03 | 08 | | | 31 |
| LJUBLJANA | YUGOSLAVIA | 20 | 23.6 | 54.3 | 18 | 05 | 35 | | | 1016.4 | | | | | | | |
| MEDIC | U.K. | 22 | 23.8 | 60.2 | 00 | 36 | 35 | | | 1013.7 | | | 02 | 05 | 10 | 08 | 13 |
| AMELIA | | | | | | | | | | | | | | | | | |
| (NO SHIPS) | | | | | | | | | | | | | | | | | |
| BESS | | | | | | | | | | | | | | | | | |
| (NO SHIPS) | | | | | | | | | | | | | | | | | |
| CORA | | | | | | | | | | | | | | | | | |
| (NO SHIPS) | | | | | | | | | | | | | | | | | |
| DEBRA | | AUG | | | | | | | | | | | | | | | |
| DELTA ARGENTINA | U.S.A. | 27 | 25.2 | 88.6 | 06 | 14 | 35 | | | 1016.0 | | | 05 | 10 | 14 | 06 | 10 |
| SHIP | | 28 | 27.9 | 91.3 | 12 | 16 | 45 | | | 1012.5 | | | | | | | |
| ARCO HERITAGE | U.S.A. | 28 | 26.2 | 90.4 | 12 | 16 | 35 | | | 1011.2 | | | 04 | 08 | 16 | 07 | 13 |
| ARCO HERITAGE | U.S.A. | 28 | 26.0 | 89.8 | 15 | 17 | 35 | | | 1012.8 | | | 04 | 08 | 16 | 08 | 11 |
| TRANSPANAMA | U.S.A. | 28 | 26.0 | 92.4 | 15 | 12 | 45 | | | 1009.1 | | | 06 | 03 | 12 | 12 | 23 |
| TREIN MARSK | DENMARK | 28 | 28.2 | 90.3 | 18 | 18 | 35 | | | 1014.0 | | | | | | | |
| RIVERINA | U.K. | 28 | 29.1 | 93.6 | 18 | 11 | 35 | | | 1006.0 | | | 05 | 13 | 14 | 05 | 11 |
| TEXACO MASSACHUSETTS | U.S.A. | 28 | 27.5 | 92.8 | 18 | 20 | 35 | | | 1008.1 | | | 07 | 11 | 20 | 07 | 15 |
| TRANSPANAMA | U.S.A. | 28 | 28.0 | 92.1 | 18 | 15 | 40 | | | | | | 08 | 13 | 14 | 08 | 10 |
| MARCONA CONVEYOR | LIBERIA | 28 | 27.6 | 91.4 | 18 | 16 | 40 | | | | | | | | | | |
| EXXON NEWARK | U.S.A. | 29 | 27.3 | 91.2 | 00 | 16 | 40 | | | 1010.5 | | | 03 | 08 | 16 | 05 | 11 |
| MARCONA CONVEYOR | LIBERIA | 29 | 28.0 | 92.8 | 00 | 19 | 35 | | | 1009.3 | | | 05 | 08 | 18 | 09 | 11 |
| ELLA | | AUG | | | | | | | | | | | | | | | |
| HORNWIND | GERMANY | 30 | 27.7 | 63.0 | 20 | 06 | 45 | | | 1010.9 | | | 07 | 16 | 09 | 09 | 16 |
| ROSTOCK | GERMANY | 31 | 29.2 | 68.8 | 16 | | 70 | | | 980.0 | | | | | | | |
| | | SEP | | | | | | | | | | | | | | | |
| CLYTONEUS | U.K. | 1 | 30.9 | 71.5 | 12 | 15 | 35 | | | 1010.5 | | | 04 | 08 | | 12 | 10 |
| CLYTONEUS | U.K. | 1 | 31.5 | 71.9 | 15 | 13 | 35 | | | 1015.5 | | | 03 | 07 | 13 | 13 | 10 |
| THAMESFIELD | U.K. | 2 | 31.1 | 73.2 | 12 | 24 | 40 | | | 1011.0 | | | 05 | 05 | 28 | 09 | 05 |
| THAMESFIELD | U.K. | 2 | 30.6 | 72.7 | 18 | 20 | 40 | | | 1011.0 | | | 07 | 05 | 27 | 09 | 16 |
| THAMESFIELD | U.K. | 3 | 31.0 | 72.5 | 00 | 24 | 35 | | | 1011.7 | | | 06 | 06 | 22 | 10 | 16 |
| THAMESFIELD | U.K. | 3 | 31.0 | 73.1 | 06 | 21 | 35 | | | 1012.5 | | | 06 | 05 | 23 | 08 | 16 |
| NORDPOL | DENMARK | 3 | 32.6 | 71.4 | 06 | 18 | 40 | | | 1005.9 | | | | | | | |
| SHIP | | 3 | 33.8 | 71.7 | 18 | 29 | 45 | | | 1004.9 | | | | 25 | | | |
| SUMMIT VENTURE | LIBERIA | 3 | 33.7 | 68.2 | 18 | 19 | 35 | | | 1009.5 | | | 09 | 23 | 19 | 11 | 23 |
| DORIC | PANAMA | 3 | 35.1 | 67.8 | 21 | 16 | 50 | | | 1001.0 | | | 08 | 15 | | | |
| STATENDAM | NETHERLANDS | 3 | 35.3 | 67.2 | 21 | 16 | 35 | | | 1003.5 | | | 05 | 11 | 16 | 07 | 15 |
| ROTERDAM | NETHERLANDS | 3 | 34.9 | 67.1 | 21 | 13 | 35 | | | 1005.5 | | | 06 | 06 | | | |
| STATENDAM | NETHERLANDS | 4 | 34.6 | 66.6 | 00 | 16 | 45 | | | 1005.5 | | | 06 | 13 | 20 | 08 | 15 |
| MORMAC SUN | U.S.A. | 4 | 37.1 | 71.4 | 00 | 06 | 35 | | | 1006.0 | | | 06 | 07 | 23 | 13 | 08 |
| STATENDAM | NETHERLANDS | 4 | 34.5 | 65.5 | 03 | 18 | 45 | | | 1008.0 | | | 04 | 13 | | | |
| BOCKENHEIM | GERMANY | 4 | 35.9 | 58.8 | 12 | 22 | 40 | | | 1011.2 | | | | | | | |
| LF3Q | NORWAY | 4 | 42.8 | 60.5 | 18 | 04 | 45 | | | 992.7 | | | 04 | 07 | | | |
| SHIP | | 4 | 44.6 | 59.3 | 21 | 02 | 40 | | | 992.0 | | | 03 | 07 | 03 | 06 | 11 |
| SHIP | | 4 | 37.2 | 58.0 | 21 | 22 | 35 | | | 1008.5 | | | 02 | 10 | 26 | 05 | 10 |
| SHIP | | 5 | 46.2 | 46.0 | 12 | 25 | 60 | | | 988.8 | | | 07 | 20 | 25 | 07 | 36 |
| TROLL PARK | U.K. | 5 | 43.7 | 44.2 | 12 | 21 | 40 | | | 1001.8 | | | 08 | 07 | 22 | 09 | 08 |
| FLOSSIE | | SEP | | | | | | | | | | | | | | | |
| FOSSARUS | LIBERIA | 4 | 13.1 | 40.1 | 12 | 17 | 40 | | | 1009.0 | | | 06 | 15 | | | 16 |
| PICA | GERMANY | 6 | 21.7 | 55.2 | 17 | 14 | 45 | | | 1009.3 | | | 05 | 08 | 10 | 09 | 13 |
| AFRIC STAR | U.K. | 7 | 23.5 | 56.6 | 03 | 13 | 40 | | | 1013.3 | | | 06 | 08 | 13 | 08 | 20 |
| THORSWAVE | NORWAY | 12 | 33.6 | 46.2 | 12 | 04 | 35 | | | 1016.6 | | | 14 | 15 | 04 | 05 | 15 |
| SHIP | | 13 | 33.0 | 43.7 | 09 | 02 | 50 | | | 1001.0 | | | | | 03 | | 15 |
| POINTE SANS SOUCI | FRANCE | 13 | 32.5 | 43.5 | 09 | 02 | 50 | | | 1006.0 | | | 05 | 11 | | | |
| POINTE SANS SOUCI | FRANCE | 13 | 32.9 | 43.6 | 12 | 04 | 60 | | | 997.5 | | | | 36 | | | |
| SNOW BALL | SWEDEN | 13 | 32.0 | 42.2 | 12 | 14 | 75 | | | 1010.1 | | | | | | | |
| MANISTEE | U.K. | 13 | 33.6 | 42.9 | 18 | 14 | 35 | | | 997.9 | | | 03 | 03 | 01 | 07 | 15 |
| BREMERHAVEN | GERMANY | 14 | 32.3 | 45.1 | 00 | 33 | 45 | | | 1009.9 | | | | 13 | 32 | 09 | 16 |
| AMERICA STAR | U.K. | 14 | 36.8 | 43.6 | 06 | 02 | 40 | | | 1006.2 | | | 06 | 16 | | | |
| SHIP | | 15 | 48.5 | 30.6 | 21 | | 40 | | | 1012.2 | | | | | | | |
| GRETA | | SEP | | | | | | | | | | | | | | | |
| AQUILON | FRANCE | 14 | 12.9 | 65.8 | 15 | 12 | 35 | | | 1014.0 | | | 05 | 05 | | | |
| S. FELICE | ITALY | 14 | 13.8 | 68.0 | 15 | 11 | 40 | | | 1010.5 | | | 10 | 13 | | | |
| S. FELICE | ITALY | 14 | 14.1 | 67.2 | 21 | 12 | 35 | | | 1010.2 | | | 10 | 13 | | | |
| REMUERA | U.K. | 15 | 16.8 | 76.0 | 12 | 08 | 35 | | | 1012.3 | | | 04 | 13 | 08 | 07 | 15 |
| PERSIMMON | GERMANY | 15 | 14.3 | 70.9 | 15 | 11 | 35 | | | 1010.5 | | | 07 | 13 | 11 | 08 | 10 |
| MONSOON | BELGIUM | 16 | 13.7 | 74.7 | 00 | 06 | 35 | | | 1000.0 | | | 11 | 16 | | | |
| AUSTRAL ENTENTE | U.S.A. | 16 | 17.0 | 75.0 | 06 | 09 | 35 | | | 994.6 | | | 06 | 13 | | | |
| AUSTRAL ENTENTE | U.S.A. | 16 | 16.0 | 75.9 | 09 | 09 | 35 | | | | | | 08 | 13 | | | |
| SHIP | | 16 | 16.0 | 76.0 | 09 | 10 | 40 | | | 1007.4 | | | 03 | 13 | | 10 | 20 |
| AUSTRAL ENTENTE | U.S.A. | 16 | 14.5 | 76.0 | 15 | 09 | 35 | | | 1009.5 | | | 06 | 07 | 09 | 11 | 11 |
| VANTAGE HORIZON | U.S.A. | 17 | 15.5 | 80.2 | 18 | 14 | 50 | | | | | | 18 | 10 | 14 | | 15 |
| OVERSEAS ALASKA | U.S.A. | 17 | 16.9 | 82.0 | 21 | 09 | 35 | | | 1007.2 | | | 10 | 08 | 07 | 11 | 33 |
| WASHINGTON TRADER | U.S.A. | 18 | 17.3 | 82.8 | 00 | 08 | 35 | | | 1007.8 | | | 07 | 25 | | | |
| SHIP | | 18 | 12.5 | 82.4 | 00 | 07 | 35 | | | 998.1 | | | | | | | |
| ATHERSTONE | U.K. | 18 | 20.3 | 86.7 | 14 | 07 | 40 | | | 1011.7 | | | 03 | 07 | 12 | 06 | 11 |
| HOPE | | SEP | | | | | | | | | | | | | | | |
| NETUNO | BRAZIL | 15 | 31.5 | 65.0 | 12 | 07 | 40 | | | 1013.0 | | | 06 | 03 | | | |
| OBELIX | LIBERIA | 15 | 32.6 | 62.8 | 12 | 06 | 35 | | | 1012.0 | | | | | | | |
| MAUMEE | U.S.A. | 15 | 29.4 | 62.0 | 18 | 24 | 35 | | | 1009.1 | | | 06 | 11 | 26 | 09 | 11 |
| NAI LUISA | ITALY | 17 | 34.0 | 54.0 | 18 | 27 | 40 | | | 1006.3 | | | | | 19 | | 10 |
| JACOB VAN HEEMSHERK | NETHERLANDS | 18 | 36.1 | 40.3 | 18 | 22 | 35 | | | 1008.0 | | | 03 | 07 | | | |
| BANGLAR MANN | | 19 | 42.5 | 36.7 | 12 | 27 | 40 | | | 986.5 | | | | | 18 | | 08 |
| DART CANADA | U.K. | 20 | 43.6 | 29.9 | 06 | 22 | 40 | | | 1006.3 | | | | | | | |
| IRMA | | OCT | | | | | | | | | | | | | | | |
| METEOR | U.S.A. | 5 | 39.2 | 25.7 | 12 | 15 | 40 | | | | | | | | | | |
| POINTE MADAME | FRANCE | 5 | 42.3 | 24.0 | 18 | 17 | 40 | | | | | | | 20 | | | |
| JULIET | | OCT | | | | | | | | | | | | | | | |
| SHIP | | 8 | 19.6 | 59.2 | 18 | 09 | 35 | | | 1010.5 | | | | | | | |
| SHIP | | 9 | 19.5 | 60.4 | 00 | 09 | 40 | | | 1013.0 | | | | | | | 12 |
| MAGNUS VI | GERMANY | 9 | 19.9 | 58.6 | 00 | 12 | 40 | | | 1015.0 | | | | 18 | | | |
| IRON ENDEAVOUR | U.K. | 9 | 20.8 | 62.3 | 18 | | 35 | | | 1011.0 | | | | | | | |
| LAND OF LIBERTY | LIBERIA | 10 | 28.4 | 76.2 | 18 | 14 | 35 | | | 1008.5 | | | | 12 | | | |
| HOLLANDIA | NETHERLANDS | 10 | 25.9 | 68.9 | 18 | 14 | 45 | | | 1010.0 | | | 04 | 06 | 03 | 06 | 07 |
| UNIQUE STAR | PANAMA | 11 | 26.3 | 75.7 | 06 | 29 | 35 | | | 1008.5 | | | 05 | 06 | | | 07 |
| KENDRA | | OCT | | | | | | | | | | | | | | | |
| SEA RACER | | 29 | 24.0 | 73.0 | 00 | 70-kn gust | | | | 999.0 | | | | | | | |
| SHIP | | 30 | 23.0 | 72.0 | 00 | 14 | 40 | | | 1008.0 | | | | | | | |
| KELKHEIM | GERMANY | 30 | 26.3 | 73.4 | 00 | 32 | 35 | | | | | | | | | | |
| BISCHOFSTOR | GERMANY | 30 | 28.7 | 69.0 | 00 | 12 | 35 | | | 1016.8 | | | 04 | 07 | 17 | | 08 |
| EXXON HOUSTON | U.S.A. | 30 | 30.7 | 79.1 | 06 | 06 | 35 | | | 1017.0 | | | 03 | 05 | 08 | 06 | 10 |
| STEPHANITOR | GERMANY | 30 | 31.2 | 71.1 | 18 | 08 | 35 | | | 1013.5 | | | 05 | 10 | | 08 | 15 |
| | | NOV | | | | | | | | | | | | | | | |
| STEPHANITOR | GERMANY | 1 | 34.6 | 69.1 | 18 | 30 | 35 | | | 1013.5 | | | 06 | 10 | 18 | 10 | 13 |
| SUNFRANCIS | GERMANY | 1 | 36.9 | 60.9 | 18 | 27 | 40 | | | 1005.6 | | | | | | | |

+ Direction for sea waves same as wind direction.

Figure 11.--The muddy, swirling waters of the rain-swollen Guadalupe River surge past the downtown section of Herrville, Tex., following Amelia's heavy rains. Near Medina, Tex., 2 in of rain fell in 1 hr. Wide World Photo.

TROPICAL STORM AMELIA, JULY 30-31

Amelia was a short-lived tropical storm in the extreme western Gulf of Mexico that will be remembered for producing extreme rainfall over central Texas. Rainfall of 26 in in 12 hr was reported just north of Abilene with similar readings over a large area, causing disastrous flooding in a number of river basins in central Texas (fig. 11). There were 33 known deaths in connection with Amelia, and property damage is estimated at $20 million.

Amelia began as a tropical wave moving westward off the African coast on July 19. She crossed the Atlantic and Caribbean as a weak wave and developed into a tropical depression with a closed-surface circulation 11 days later on July 30 in the western Gulf of Mexico near Brownsville, Tex.

Tropical-storm strength was acquired later the same day, but the storm center crossed the Texas coast between Brownsville and Corpus Christi very shortly thereafter. This abruptly ended Amelia's development. The storm's maximum sustained winds were 45 kn with a minimum pressure of 1005 mb as measured by reconnaissance aircraft.

Brownsville, the closest station to the landfall location, reported 34-kn winds. A Coast Guard cutter 60 mi southeast of Corpus Christi reported gusts to 70 kn. Rainfall amounts along the coast were in the 4- to 5-in range. Table 5 lists meteorological data from stations near the point of landfall.

Figure 12 shows a satellite picture of Amelia on the afternoon of the 30th several hours prior to landfall; it

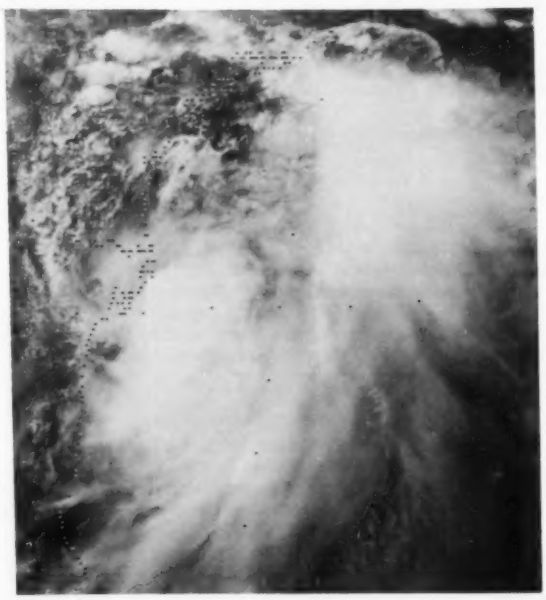


Figure 12.--Tropical storm Amelia on the afternoon of July 30, not far offshore near Brownsville, Tex.

Table 5.--Meteorological data of tropical storm Amelia, July 30-31, 1978

| Station | Date | Pressure (in) | | Wind (mi/h) | | | | Tide (ft) | | Rainfall[a] (in) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Minimum | Time[b] | Sustained | Time[b] | Peak gust | Time[b] | Ht. above norm. | Time[b] | |
| Texas | | | | | | | | | | |
| Brownsville WSO | 30 | 29.72 | 1717 | S 39 | 2304 | 43 | 2305 | | | 0.37 |
| Corpus Christi WSO | 31 | 29.78 | 0216 | SSE 38 | 0255 | 58 | 0215 | | | 3.92 |
| Harlingen substation | | | | | | | | | | 0.58 |
| Los Fresnos (farm gage) | | | | | | | | | | 4.01 |
| Padre Island ranger station | 31 | | | | | 66 | 0300 | | | |
| Port Isable | | | | | | | | | | 5.15 |
| Port Mansfield harbormaster | 30 | 29.79 | | | | NW43 | | | | 4.22 |
| South Padre Island Coast Guard | 30 | | | | | 46 | 1700 | | | |

[a]Central Texas not included

[b]Central Standard Time

can be seen that this is a poorly defined storm. However, squalls and heavy thunderstorms associated with Amelia were responsible for the loss of six craft--five commercial shrimpers and one pleasure craft. The U.S. Coast Guard rescued 34 persons at sea in connection with these incidents.

## TROPICAL STORM BESS, AUGUST 5-8

Bess, the second tropical storm in a row to develop in the western Gulf of Mexico, was of little consequence to maritime interests. This storm developed from a weak low-pressure system that formed on a dissipating cold front over Georgia on August 1. The LOW moved southwestward, developing into a tropical depression by the 5th, and reached tropical-storm strength on the 6th. Figure 13 shows Bess on the afternoon of the 6th with windspeeds of 35 to 40 kn. There is only a small amount of convective cloudiness associated with the storm at this time.

Movement toward the southwest continued and landfall occurred early on the 8th near Nautla, Mexico, about 350 mi south of Brownsville, Tex. Maximum sustained winds reached 45 kn on August 7, with a 1005-mb minimum sea-level pressure.

There were no coastal observations near the point of landfall. Winds of 25 kn were reported from Tampico and Tuxpan as the center approached the coast. There were no casualties or significant damage attributed to Bess.

## HURRICANE CORA, AUGUST 7-11

As mentioned earlier, Cora was not in the primary shipping lanes and ran her course with little impact on shipping. She started as a weather disturbance that moved off the African coast on August 4. It continued westward for 2 days and then developed into a depression. Two days later, on the 8th, the depression intensified to a tropical storm about 1,000 mi west of the Azores. Hurricane force was reached later the same day. Cora was now moving on a course slightly south of due west.

Weakening began on the 9th, when the storm was

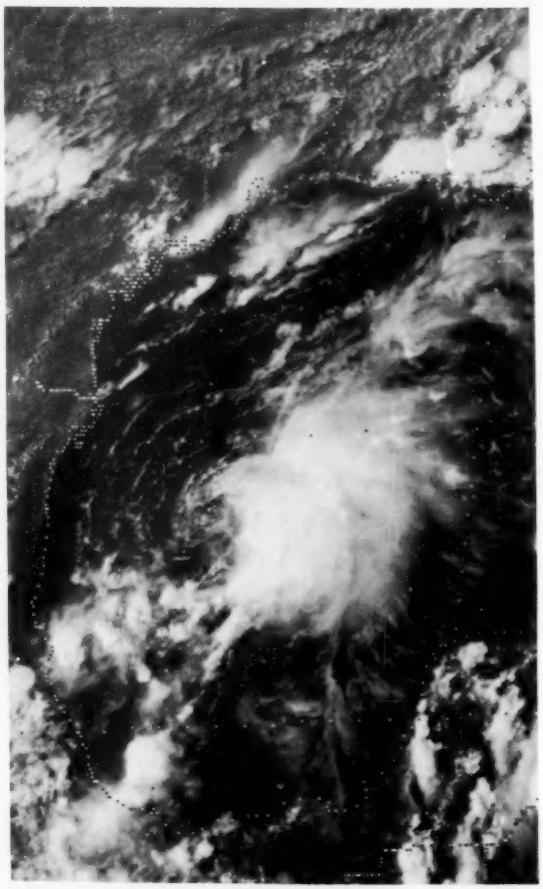


Figure 13.--Tropical storm Bess at 2101 August 6, centered about 200 mi southeast of Brownsville, Tex.

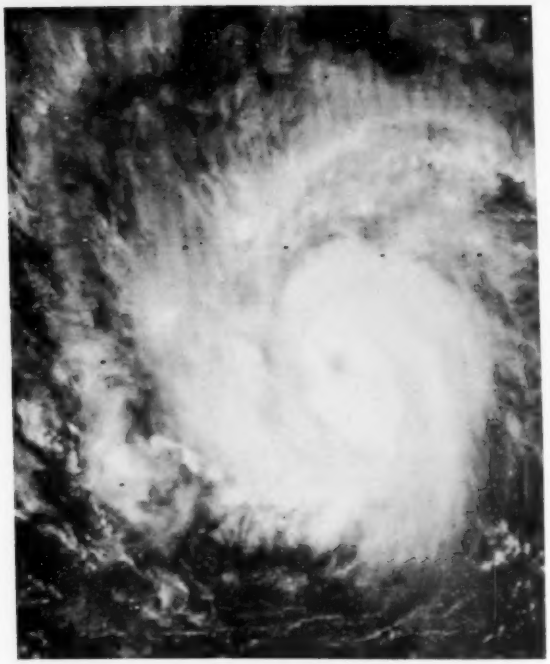


Figure 14.--Hurricane Cora at 1601 August 8 in the tropical North Atlantic, midway between Africa and the Caribbean.

still east of the Lesser Antilles. A reconnaissance flight on the 9th measured 55-kn winds, and the maximum winds decreased to 40 kn in squalls as Cora crossed the Windward Islands on the 10th and 11th. Finally, all evidence of circulation was lost, and the system dissipated as it continued into the southwestern Caribbean.

Cora was identified as a tropical storm and then a hurricane solely on the basis of satellite pictures. Maximum windspeed and minimum pressure obtained from satellite intensity classification techniques were 80 kn and 980 mb on August 9. Figure 14 shows Cora on the afternoon of the 8th, several hours prior to maximum intensity. This satellite picture shows evidence of an eye formation.

## TROPICAL STORM DEBRA, AUGUST 26-29

A tropical depression had formed at 1200 on August 26 approximately 400 mi south of New Orleans. The origin of this depression can be traced to two weather systems which interacted with each other over the south-central Gulf of Mexico. One of these was a tropical wave which had moved from the northwestern Caribbean and across the Yucatan Peninsula. The second system was an upper level LOW which drifted southwestward from Florida.

Strengthening occurred and tropical storm Debra was named at 1800 on the 28th, based on several ship reports of 35- to 45-kn winds as well as a reconnaissance aircraft estimate of 40-kn surface winds. Gale warnings were posted from Galveston, Tex., to Grand Isle, La. Figure 15 shows a satellite picture of Debra

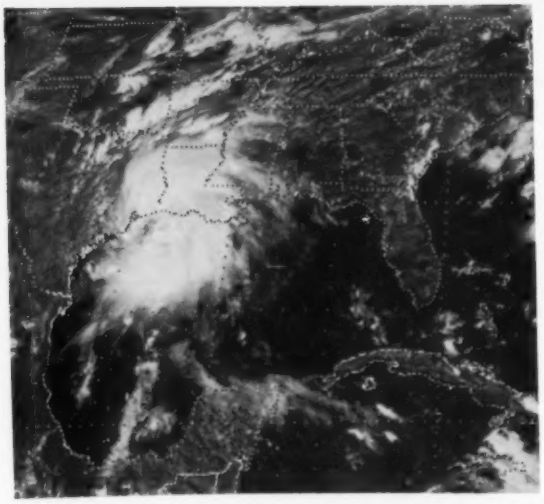


Figure 15.--Debra on the afternoon of August 28, several hours before landfall on the Louisiana coast.

on the afternoon of the 28th as she approached the Louisiana coast. This was several hours prior to maximum intensity of 50-kn winds and a 1000-mb central pressure

Note that the ships in table 4 that encountered Debra all reported winds with a southerly component. All of these ships were to the east of the storm center's track. TRANSPANAMA, one of two ships to report 45-kn winds, also reported swells to 23 ft. These ship reports confirm information from oil rigs and reconnaissance aircraft which indicates that most of the high winds associated with this storm were well east of the center.

At landfall tides ranged from 1 ft above normal at Corpus Christi to 4 to 5 ft above normal along portions of the Louisiana coast. Rainfall of up to 10 in and several tornadoes were reported. One death was attributed to a tornado in Mississippi, and another death occurred on an offshore oil rig. Storm damage was considered minimal. An estimated 3,000 persons were evacuated from low-lying coastal sections of Louisiana. Table 6 gives a summary of landfall observations.

Table 6.--Meteorological data of tropical storm Debra, August 26-29, 1978

| Station | Date | Pressure (in) | | Wind (mi/h) | | | | Tide (ft) | | Rainfall (in) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Minimum | Time[a] | Sustained | Time[a] | Peak gust | Time[a] | Ht. above norm. | Time[a] | |
| Louisiana | | | | | | | | | | |
| Alexandria WSO | 28 | 29.68 | 2300 | 31 | | 45 | 2030 | | | 4.53 |
| Alexandria powerplant | | | | | | | | | | 5.03 |
| Baton Rouge WSO | 29 | 29.80 | 0353 | 23 | 0705 | 39 | 0700 | | | 3.61 |
| Fort Pike on Rigolets | 29 | | | | | | | 3.8[b] | 1345 | |
| Freshwater Bayou Lock | 29 | | | | | | | | | 10.81 |
| Grand Chenier | 28 | | | | | 8 66 | | | | |
| Lake Charles WSO | 29 | 29.50 | 1953 | 28 | 1913 | 38 | 1925 | | | 5.89 |
| Lake Pontchartrain north causeway | 28 | | | | | | | 3.24[b] | 2303 | |
| New Orleans Moisant airport | 28 | | | 22 | 1313 | SE 39 | 1924 | | | |
| | 29 | 29.92 | 0245 | | | | | | | 3.28 |
| Mississippi | | | | | | | | | | |
| Brookhaven | 29 | | | | | | | | | 6.31 |
| Bude | 29 | | | | | | | | | 6.50 |
| Clinton | 29 | | | | | | | | | 4.66 |
| Crystal Springs | 29 | | | | | | | | | 3.47 |
| Jackson WSFO | 29 | 29.84 | 1000 | SE 29 | 1002 | SE 41 | 1000 | | | 0.95 |
| Jackson(northeast) | 29 | | | | | | | | | 2.99 |
| Liberty | 29 | | | | | | | | | 6.60 |
| McComb | 29 | | | | | | | | | 2.70 |
| Texas | | | | | | | | | | |
| Beaumont WSO | 28 | 29.58 | 1900 | | | | | 1.8 | 1200 | |
| | 29 | | | SW 23 | 0030 | SW 32 | 0030 | | | 2.81 |
| Galveston WSO | 28 | 29.68 | 1745 | N 30 | 1327 | NE 38 | 1003 | 2.2 | 1145 | 0.29 |

[a]Central Standard Time

[b]Height above Mean Sea Level

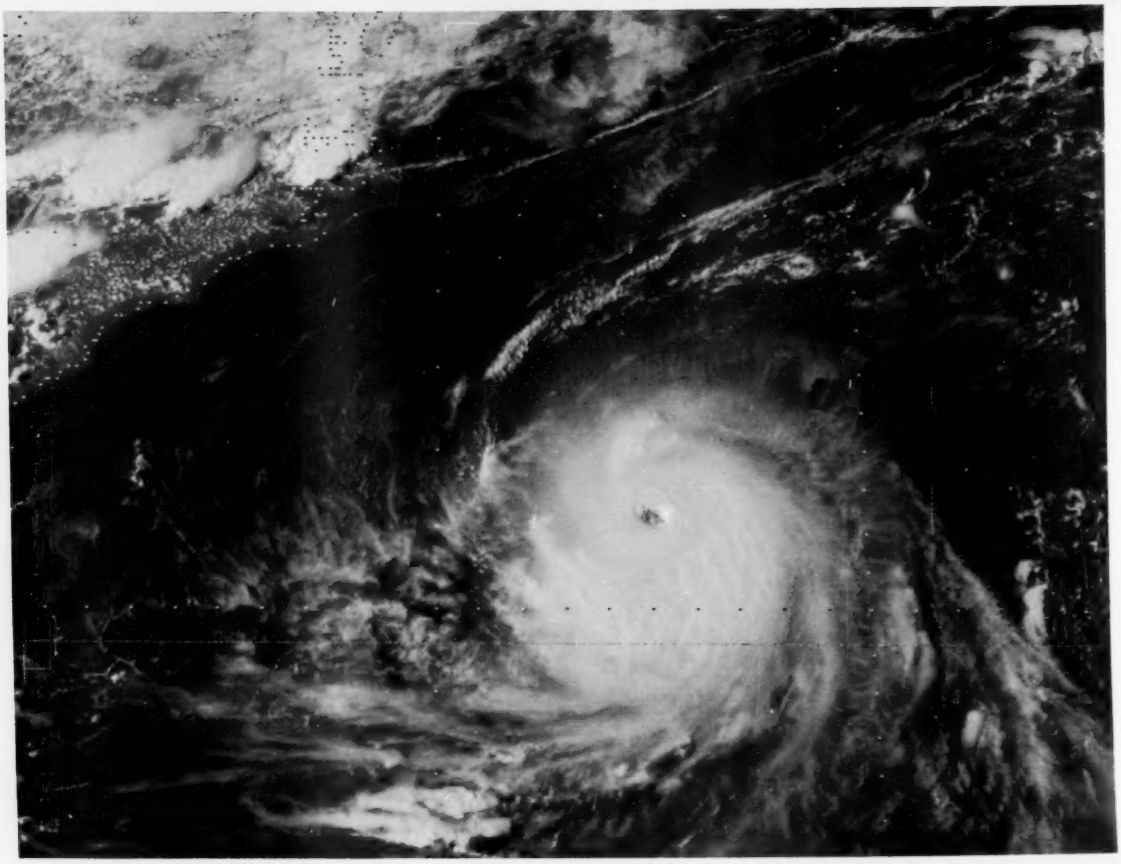


Figure 16.--Hurricane Ella, 300 mi southeast of Cape Hatteras.

HURRICANE ELLA, AUGUST 29-SEPTEMBER 5

Ella formed within the cloudiness associated with an old frontal zone in the southwestern North Atlantic. By 0000 on August 30, a ship and satellite data indicated that a tropical depression had formed 500 mi to the south of Bermuda. The depression moved toward the west-northwest. The HORNWIND, just north of the circulation center, reported 45-kn winds along with 16-ft seas at 2000 on the 30th, indicating that tropical-storm strength had been reached several hours earlier.

Almost 24 hr later, the ROSTOCK reported 70-kn winds and 980-mb pressure, as it passed very close to Ella's center. This information agreed closely with a reconnaissance aircraft mission, and Ella was upgraded to a hurricane at 1800 on the 31st, while about 500 mi southeast of Cape Hatteras, N.C.

The hurricane decelerated and began turning northward on September 1; but recurvature was not complete, and Ella drifted slowly northward for 24 hr. Some weakening occurred at this time. After reaching 959 mb at 2100 on the 1st, the central pressure increased more than 20 mb. A satellite picture at 1931 on September 1 (fig. 16) shows Ella's well-defined eye. The North Carolina coast is outlined in the upper left portion of the picture.

Finally, on the 3d Ella responded to a trough moving eastward from the Great Lakes and recurved, accelerating toward the northeast with a forward speed of up to 40 kn. It was during this period of September 3 to 5 that most of the ships in table 4 encountered the storm. Ella deepened again, this time to 956 mb with 120-kn winds--Ella's maximum intensity. She passed close to the southeastern tip of Newfoundland and then became extratropical.

A hurricane watch was issued for the Outer Banks of North Carolina on September 1, the beginning of Labor Day weekend. As it turned out, the only storm effect was beach erosion to the Outer Banks, but the media reported that the tourist industry in this area was adversely affected from publicity concerning the hurricane threat.

HURRICANE FLOSSIE, SEPTEMBER 3-16

Flossie's activities were confined to the open North Atlantic, and this storm was never a threat to land. A wave, midway across the Atlantic, strengthened into a depression early on September 4. The FOSSARUS reported 40-kn winds at 1200, which resulted in the upgrading of Flossie to tropical-storm status. Flossie

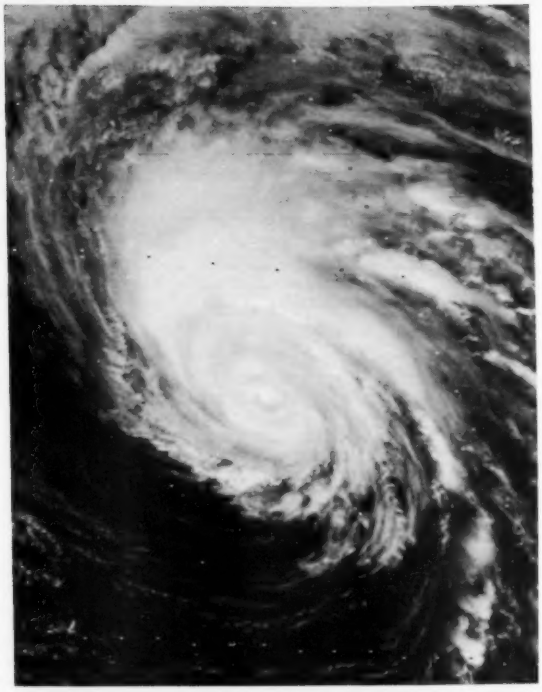


Figure 17.--Hurricane Flossie, far out in the North Atlantic at midday on September 13.

traveled west to northwestward for several days, then began recurving, and weakened again to a tropical depression. By the 9th the system was moving northeastward and strengthened again, reaching storm strength on the 10th.

Far out in the Atlantic, Flossie stalled on the 12th. An eye structure became visible on satellite pictures, and hurricane status was assigned. The SNOW BALL reported 75-kn winds at 1200 on the 13th (fig. 17).

Flossie reached maximum intensity of 85 kn with a pressure of 976 mb early on the 13th. She continued toward the northeast and then became extratropical on the 15th about 700 mi north of the Azores.

HURRICANE GRETA, SEPTEMBER 13-20

Greta originated from a tropical wave which crossed the Atlantic immediately after the system which produced Flossie. However, the system that was to become Greta continued westward and moved into the Caribbean on September 13. Winds gusting to 45 kn were reported from Barbados as the wave passed.

A depression formed immediately thereafter, centered 75 mi west-northwest of Port of Spain, Trinidad, not a favorable location for tropical development. The depression was named at 1200 on the 14th, just north of Netherlands Antilles, and Greta reached hurricane intensity 2 days later south of Jamaica. Winds reached a maximum of 115 kn and the central pressure fell to 947 mb as the hurricane eye approached the northeastern tip of Honduras. The eyewall struck a relatively undeveloped coastal section, but nearby Puerto Lempira reported winds of 70 kn gusting to 100 kn. Figure 18 shows Greta several hours prior to striking the Honduras coast.

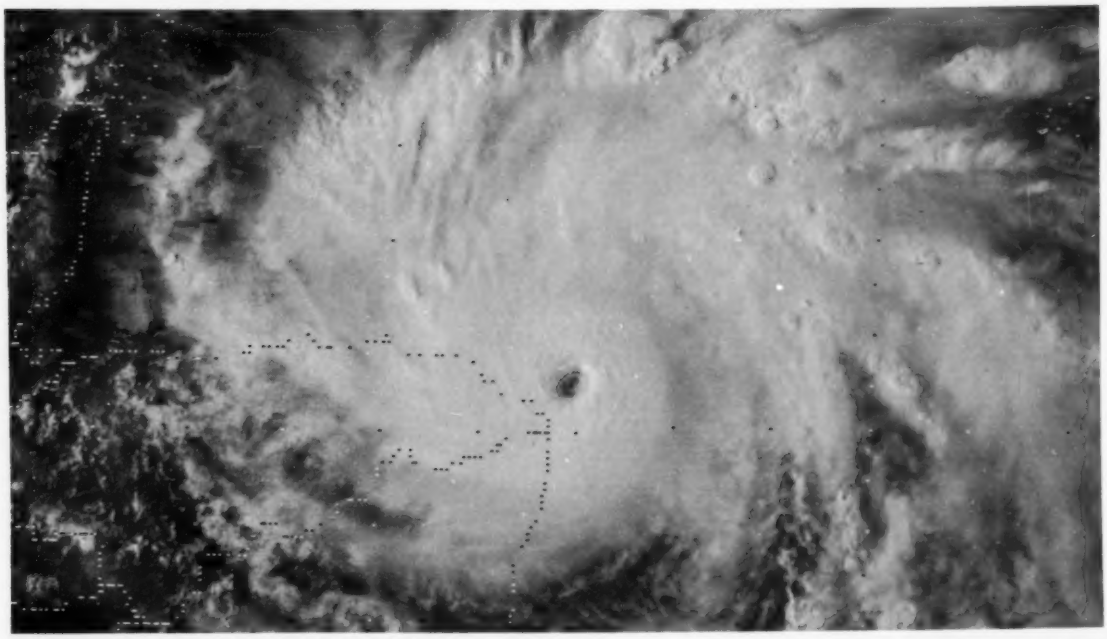


Figure 18.--Hurricane Greta with winds over 100 kn as she approached the coast of Honduras at 2101 on September 17.

Remaining partially offshore, the storm weakened and continued westward, crossing the Islas de la Bahia and landfalling on the coast of Belize near Stann Creek at 0000 on the 19th.

According to records as far back as 1886, the 4 yr between Greta and the previous hurricane in the Caribbean is the longest hurricane-free period of record. In 1974 Fifi passed through the same area on a remarkably similar track. Also, each storm eventually crossed Central America and southern Mexico to reform in the Pacific. Further, in both cases the reformed system became the 15th named storm of the eastern North Pacific season. Fifi became Orlene and Greta became Olivia.

Greta was a more intense storm than Fifi; yet, Fifi caused torrential rains in Honduras and thousands died. Only a few deaths were reported in connection with Greta, one in Honduras and four in Belize.

TROPICAL STORM HOPE, SEPTEMBER 11-21

Hope developed in the subtropics from a low-pressure system off the northeast coast of Florida on September 11. She tracked in an eastward direction for several days as a subtropical depression.

Satellite pictures revealed that the associated cloudiness had taken on a tropical appearance by the 17th, and Hope was named at 0600. The NAI LUISA confirmed this analysis 12 hr later with westerly winds of 40 kn very close to the storm's center.

Hope was now heading toward the northeast, and the BANGLAR MANN reported identical westerly winds at 1800 on the 19th as well as a 986-mb pressure reading while very close to the center. A satellite picture of Hope between the times of these ship reports is seen in figure 19.

Figure 19.--Tropical storm Hope in the central North Atlantic on September 18.

Hope reached maximum strength of 55-kn winds several hundred miles northwest of the Azores on the 19th. Hope did not affect land, and there were no marine-related incidents.

TROPICAL STORM IRMA, OCTOBER 2-5

Irma, one of many short-lived storms this season, spent its entire history in the eastern North Atlantic. Like the previous storm, this one also had a subtropical origin and became a storm near latitude 35°N, just south of the Azores on October 4. Tropical-storm advisories were issued for the islands, but Irma passed midway between the westernmost islands and the central Azores with little impact.

The only gale-force winds reported were from the METEOR and POINTE MADAME, well to the east of the storm's center. Irma is seen in figure 20, while approaching the Azores. The storm lost its identity on the 5th as it was overtaken by a strong frontal system.

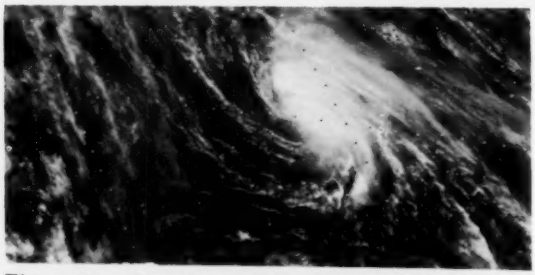


Figure 20.--Irma is caught in this satellite picture at 1401 on October 4.

TROPICAL STORM JULIET, OCTOBER 7-11

Juliet was a poorly organized tropical storm for a 3-day period over the southwestern North Atlantic. Figure 21 shows the storm at midday on October 9 during the time of maximum intensity--45-kn winds

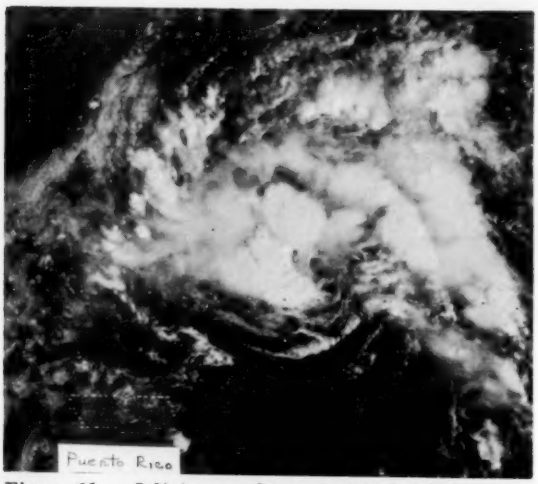



Figure 21.--Juliet, seen here at 1333 October 9, was a poorly organized storm throughout its duration.

and a 1006-mb central pressure--while northeast of Puerto Rico. The HOLLANDIA reported a windspeed of 45 kn on the 10th while less than 100 mi east of the storm's center.

Juliet was classified as a tropical depression on October 7 at a position 600 mi east of San Juan and was upgraded to a tropical storm on the 9th. The storm recurved and was last located 300 mi southwest of Bermuda before it was absorbed by a nontropical low-pressure system. Remnants of Juliet moved across Bermuda late on the 11th and produced 3 in of rain in a 12-hr period.

HURRICANE KENDRA, OCTOBER 28-NOVEMBER 3

The last named storm of the season originated from an interaction between a tropical disturbed-weather system moving northward from the Caribbean and an old frontal zone. Rainfall amounts of up to 18 in were measured in Puerto Rico during this period of development, causing one death and about $6 million in damages.

Kendra was named at 0000 on October 29 while east of the Bahamas. The SEA RACER reported gusts to 70 kn and a 999-mb pressure at this time. Kendra became a minimal hurricane on the 29th (fig. 22) and 30th with 70-kn sustained winds and a 990-mb central pressure.

Gale warnings were issued along the North Carolina coast on the 30th, but Kendra moved away to the northeast. Minor damage from beach erosion was reported along the southeast coast of the United States.

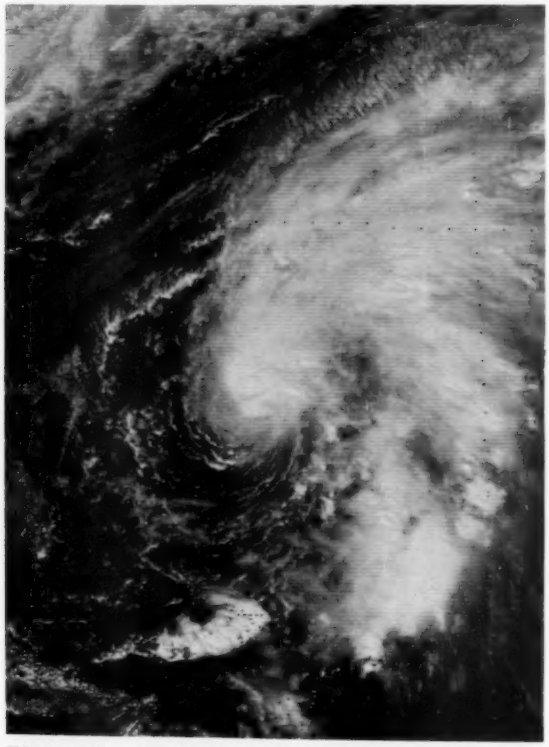


Figure 22.--Kendra on October 29, just east of the Bahamas.

SUBTROPICAL STORM, JANUARY 18-22

Historical records indicate that this is the first known storm with tropical characteristics to form in January. (A hurricane in the Leeward Islands during January 1955 actually became a storm on December 30.)

This system originated 1,500 mi east-northeast of Puerto Rico on January 18. It traveled generally in a westward direction for several days and dissipated late on the 22d about 200 mi north of Puerto Rico. The storm track is given in figure 10 as system number 1. Figure 23 shows a picture of this subtropical system during its period of maximum strength of 40-kn winds and a 1002-mb central pressure. This picture illustrates how very little convection (and rainfall) was associated with the storm, which is a primary reason for distinguishing it from pure tropical systems.

Table 4 lists a number of ships with gale-force winds. Note that most of these reports are accompanied by rather high pressure readings, indicating that the maximum winds in a subtropical cyclone are some distance from the storm center.

Figure 23.--Subtropical storm on the afternoon of January 21.

# SUDDEN GALE HITS PACIFIC NORTHWEST TUNA FLEET

Robert W. Anderson
National Weather Service, NOAA
Seattle, Wash.

A sudden gale just off the coast of Washington and Oregon struck the albacore tuna fleet on September 8 and 9, 1978. It claimed two lives, sank six boats, and initiated an immense rescue and assistance effort by the U.S. Coast Guard. The weather system was not particularly intense compared to many other Pacific Northwest storms; however, these more vigorous storms are more likely to occur during fall and winter. The fact that this gale occurred in early September preceded by a week of relatively calm weather in the tuna grounds probably contributed significantly to the number of relatively small fishing boats that were as much as 80 mi to sea when the winds struck.

According to the Coast Guard, there were 122 search and rescue efforts. Six boats sank, and two lives were lost from one of them. The Coast Guard towed 37 vessels and escorted another 15 into safe harbor (fig. 24). In all, there were 182 incidents of assistance along the coast from the vicinity of Grays Harbor, Wash., to the southern boundary of the Thirteenth Coast Guard District at the Oregon-California border.

One fisherman, George Jameson, floated for 22 hr off the Oregon coast after his fishing boat sank. He probably owes his life to the survival suit shown in figure 25, which helped both to keep him afloat and also to conserve body heat. Included among the fishermen who were caught by the rough weather were Robert Jackson, a meteorologist at the Weather Service Forecast Office in Seattle, and Don Samuelson, a former Sea Grant Marine Field Agent for the coast of Washington. Both of them kindly provided firsthand accounts of their experiences off of Grays Harbor.

The weather system that caused this gale in the tuna grounds was at least a little different from the typical

Figure 25.--George Jameson floated 22 hr in this survival suit. Photo by Cary W. Tolman.

Figure 24.--Coast Guard cutter that helped in the rescue operations. U.S. Coast Guard Photo.

fronts or LOWs that normally move from west to east through the coastal region. The analysis for the morning of September 7 showed a weak ridge of high pressure along the Pacific Northwest coast (fig. 26). A weakening front about 300 mi offshore was moving eastward with winds of 10 to 15 kn in its vicinity. This was followed by a disturbance about 1,000 mi offshore that was more vigorous in the upper atmosphere than near the surface. This latter system was moving south of east and was expected to pass mostly to the south of the Washington coastal area.

By the afternoon of the 7th, some fast-moving energy from the approaching system reached the trough off the coast, and the pressure there lowered by about 5 mb in 12 hr. Winds in the area ranged from 10 to 25 kn. The ridge remained across western Washington through

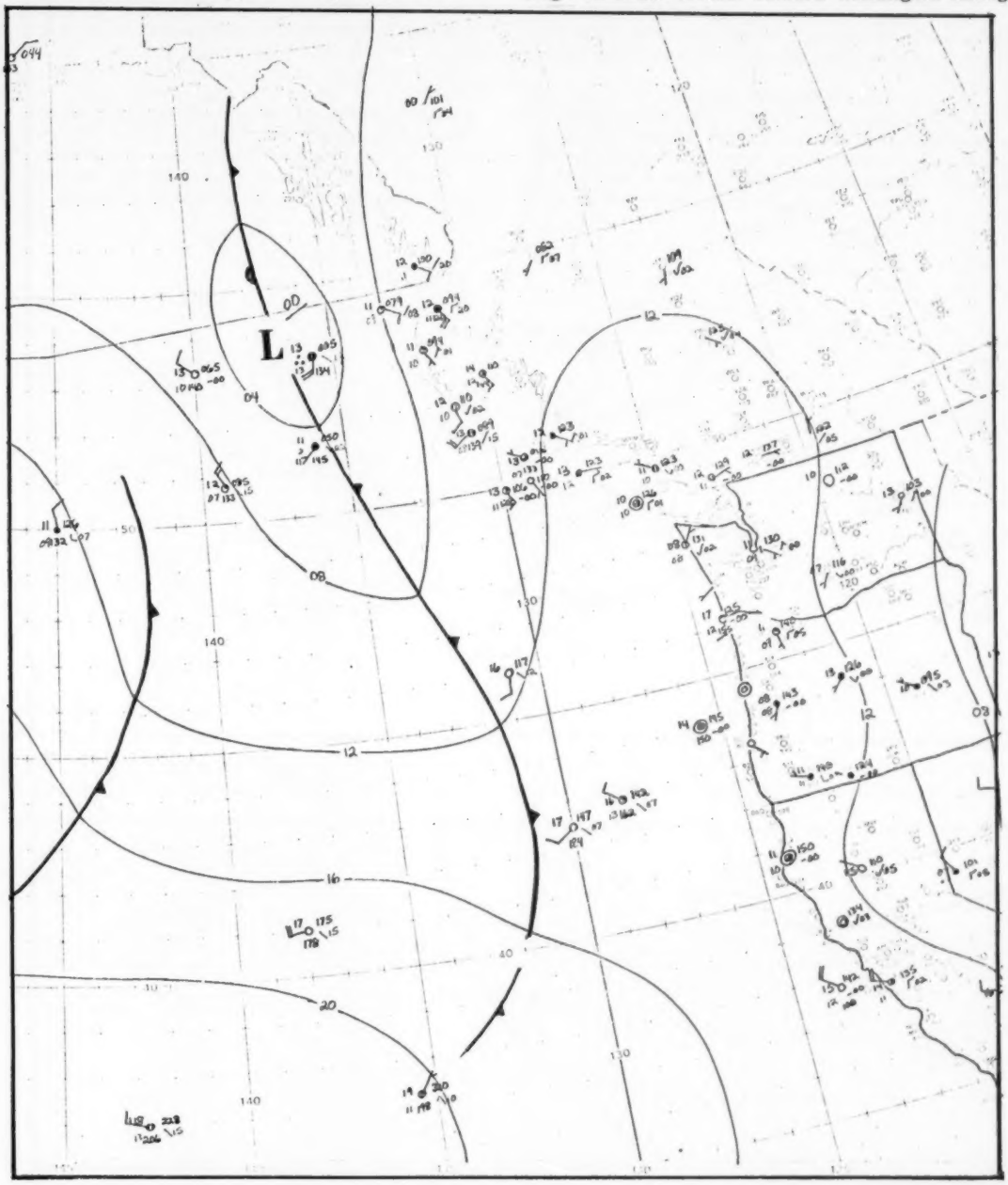



Figure 26.--Surface map of 1200 September 7, 1978.

northwestern California.

Pressures fell another 6 mb in the offshore trough by the morning of the 8th, while during the same 12-hr period pressures rose by as much as 6 mb in southeastern Oregon (fig. 27). This resulted in an increasingly strong pressure gradient in the coastal area. According to Jackson and Samuelson, winds increased to gale force and seas to 10 ft in the tuna grounds at this time, and most of the fishing fleet started to head for safe harbor. It is interesting to note that while the fishing fleet 20 to 60 mi offshore was experiencing winds estimated at 35 kn, the winds reported by Washington and Oregon coastal stations were only in the 5- to 15-kn range. At the same time, out at the NOAA buoys 250 to 300 mi from the coast, the winds were only 10 to 15 kn on the west side of the pressure trough.

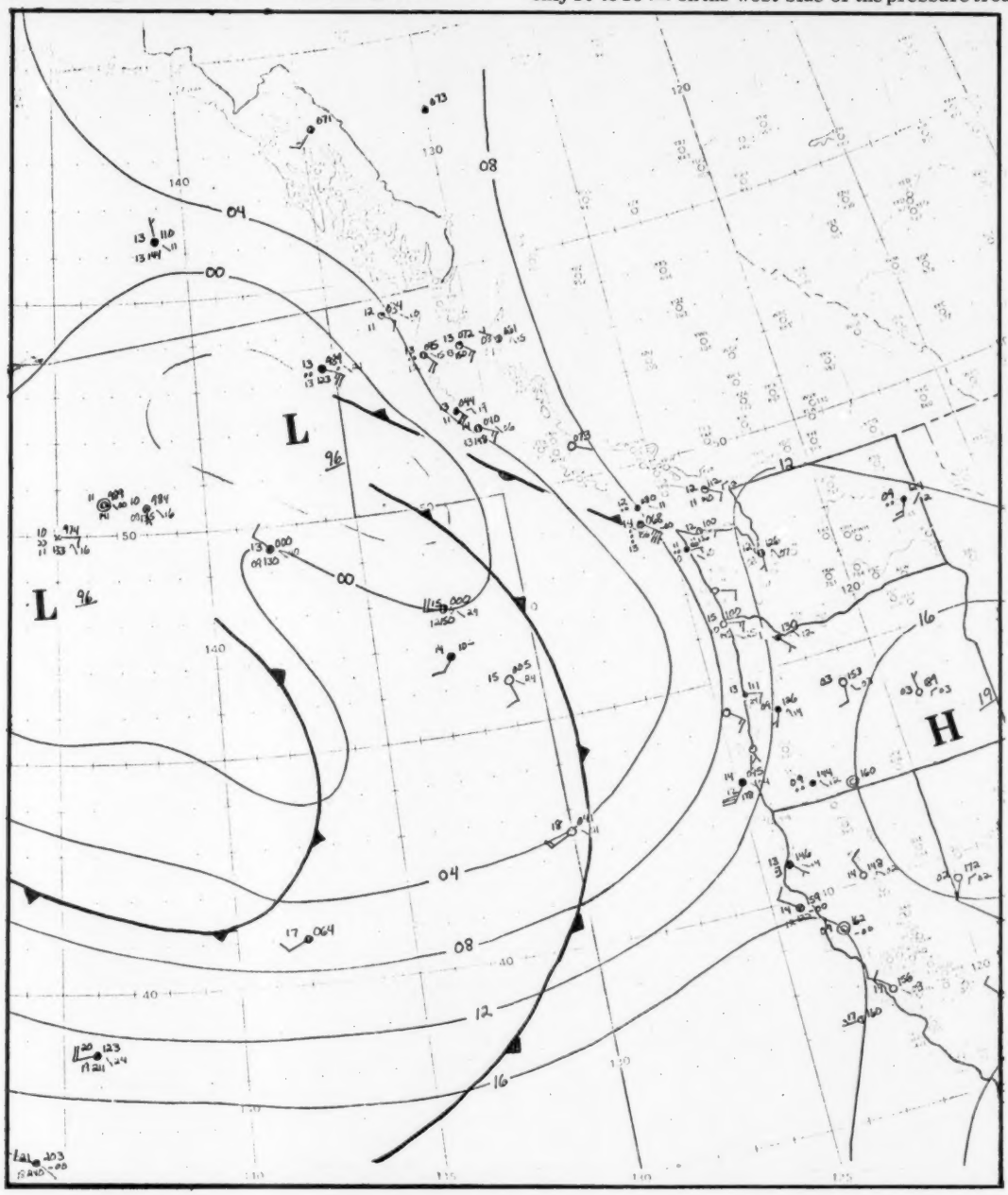



Figure 27.--Surface map of 1200 September 8, 1978.

The high winds at this time apparently occurred only in a relatively narrow north-south strip between these two areas. This phenomenon is sometimes referred to as a coastal surface jet stream. As can be seen from the above reports, the occurrence of this jet stream is often not indicated by the available weather observations.

Evidence that the system strengthened a short distance offshore is provided by the observations from the NOAA buoys, which automatically report weather every 3 hr. The one located about 300 mi off Astoria, Oreg., reported winds of only 20 kn or less through the time of the system passage, except for readings of 24 to 28 kn around midday on the 7th. The buoy located about 250 mi off Cape Blanco, Oreg., did not report winds greater than 22 kn during the period of system passage. At the Columbia River Light Vessel, located about 6 mi from the river's mouth, winds remained at 10 kn or less through 2000 PDT on the 7th and did not increase to greater than 25 kn until after 2000 PDT on the 8th.

Reports from the fishermen indicated that winds and seas decreased noticeably when their boats were within 5 to 10 mi of the coast. This was probably due at least in part to the easterly component of the wind which caused a reduction of windspeeds because of frictional drag over the land and the decrease of fetch of the wind over water as the coast was approached.

ACKNOWLEDGMENTS

The weather maps shown here were provided by John Zimmerman and William Burton of the Seattle Ocean Services Unit who are presently preparing for publication a more detailed meteorological description of this event.

THE MARINERS WEATHER LOG WELCOMES ARTICLES AND LETTERS FROM MARINERS RELATING TO METEOROLOGY AND OCEANOGRAPHY, INCLUDING THEIR EFFECTS ON SHIP OPERATIONS.

# Hints to the Observer

## IMPORTANT NOTICE

With the recent implementation of mailing the Ship's Weather Observations forms (NOAA Form 72-1) directly to the National Climatic Center, Asheville, N.C., the Port Meteorological Officer no longer sees the form or acknowledges its receipt. Starting with this issue, receipt of the forms will be acknowledged in the Mariners Weather Log under the heading "U.S. Cooperative Ship Weather Reports." The dates will correspond to the same months as the Smooth Logs, and the list will follow the tables of gale and wave observations. The list will include the ships' names in alphabetical order and the number of observations received both by radio and mail.

### GLOBAL WEATHER EXPERIMENT IS WORLDWIDE COOPERATIVE VENTURE

The largest international scientific experiment ever held got underway this year. The Global Weather Experiment, with more than 140 nations participating, seeks to gage the practical limits of weather forecasting, and design a world weather observing system to achieve them.

During the 12-mo experiment a massive array of scientific personnel and observing equipment will be monitoring the Earth's oceans and atmosphere to build the most complete record of global weather data ever assembled.

The Global Weather Experiment is part of the Global Atmospheric Research Program (GARP), a joint effort of the World Meteorological Organization (WMO) and the International Council of Scientific Unions. All 147 member nations of the WMO are involved in some way, and 70 countries and 5 international organizations are contributing directly. U.S. participation is coordinated by the Commerce Department's National Oceanic and Atmospheric Administration(NOAA). Other U.S. units participating include the Departments of Defense, Energy, Interior, Transportation, and State, the National Aeronautics and Space Administration, the National Center for Atmospheric Research, the National Science Foundation, Defense Nuclear Agency, Army, Air Force, Navy, Coast Guard, and many academic institutions. Scientific advice and liaison with the international scientific community are provided by the National Academy of Sciences.

The scope of the operation is vast. The existing World Weather Watch, which generates over 40,000 observations daily, is being supplemented by 10 space satellites, some 50 research vessels, 110 aircraft (including 10 research planes), 300 high-altitude constant-level balloons, and 300 instrumented drifting buoys.

New-generation satellites are playing a central role in the experiment. Five geostationary satellites, three from the United States, one from Japan, and one from the European Space Agency, are hovering 36,000 km above the Equator. Two new U.S. polar-orbiting satellites circle the Earth at altitudes of 830 and 870 km. Two more polar-orbiting satellites from the U.S.S.R. are also slated to participate. These spacecraft are monitoring winds (from cloud images), atmospheric temperature, and humidity. An experimental polar-orbiting U.S. satellite supplies additional information on ocean rainfall, sea-surface temperatures, and so on.

A prime focus is the broad belt around the Equator, the enormous heat sink that absorbs much of the Sun's energy and generates much of the world's weather. To get more data on this now lightly observed, but crucial region a number of special observing systems will be operated during two "special-observing periods"--January 5 to March 5 and May 1 to June 30--mostly to gather vital tropical wind information.

Some 50 ships (mainly oceanographic research vessels) from 22 nations twice daily will release balloon-borne instrument packages called "radiosondes." Ten U.S. Air Force and NOAA aircraft will fly daily sorties, dropping wind-measuring instruments over the equatorial Atlantic, the central and eastern Pacific, and the Indian Ocean. U.S. researchers will launch 150 constant-level balloons from Ascension Island in the Atlantic and Canton Island in the Pacific to monitor winds at 46,000 ft.

Virtually no weather observations now come from the lonely ocean expanses of the Southern Hemisphere. The U.S. polar-orbiting satellites help fill this data void. But to get more detailed measurements, some 300 instrumented buoys (from eight nations) have been deployed over an area latitude 20° to 60°S to provide sea-surface temperatures and atmospheric pressure.

Over the entire year, 20 specially equipped, wide-bodied commercial jets on international routes will automatically transmit wind, temperature, and pressure data to satellite receivers. Another 80 or so commercial jets will be supplying this same sort of information on a delayed basis.

All of these systems will generate weather data for the 85 percent of the Earth's area which is not now covered by the World Weather Watch. Since weather in the equatorial belt and the Southern Hemisphere has a powerful influence on conditions to the north, such information is necessary for extended forecasting.

Once the Global Weather Experiment ends on November 30, 1979, the mass of data will be processed first by centers in a number of nations and then forwarded to World Data Centers in Moscow and Washington, D.C., and to meteorological research laboratories in Bracknell, England, and Princeton, N.J. There, scientists using giant computers will refine the data and for the first time construct a complete

12-mo world weather history.

The researchers will then be able to run computer experiments using this unique record to test their results. The outcome of these experiments should enable scientists to not only determine the ultimate limits of weather prediction, but also what weather data are necessary to reach these limits, and what kind of global-observing system is needed to gather this data.

It will take at least several years for the scientists to produce these answers, but the results could be far reaching. The potential socio-economic impact of improved extended weather forecasts could be dramatic. Many industries--construction, agriculture, transportation, energy, and others--would benefit enormously from better knowledge of what the weather would be as far as 8 to 10 (or even 14) days in advance.

# Tips to the Radio Officer

Thomas H. Reppert
National Weather Service, NOAA
Silver Spring, Md.

CORRECTIONS TO WORLDWIDE MARINE WEATHER BROADCASTS (July 1977 Edition)

Page 18 - 1-0790
Los Angeles, CA (KOK)
Delete frequency 12933, insert 12993.

Page 37 - 2-0330
Charleston, SC (NMB)

| | | |
|---|---|---|
| 0420, 1620 | 2670 | W, F |
| every 4 hours | 157.1 MHz | W, F |
| after 0300 | | |

2-0350
Mayport, FL (NMA-10)

| | | |
|---|---|---|
| 0620, 1820 | 2670 | W, F |
| every 4 hours | 157.1 MHz | W, F |
| after 0330 | | |

2-0380
Miami, FL (NCF)

| | | |
|---|---|---|
| 0350, 1550 | 2670 | W, F |
| every 4 hours | 157.1 MHz | W, F |
| after 0030 | | |

CORRECTIONS TO RADIO STATIONS ACCEPTING SHIPS' WEATHER AND OCEANOGRAPHIC OBSERVATIONS (July 1978 Edition)

Page 6 - Boston, MA (NMF)
Delete frequency 8728, insert 8459.

Page 8 - San Francisco, CA (NMC)
Delete frequency 16889.9, insert 16880.0.

ACKNOWLEDGMENTS

Thanks to Radio Officers Soren Christensen, M/V TREIN MAERSK; L.A. v.d. Hoeven, M/V MERCURIUS; and Nyral A. Karim, SS LNG ARIES; for recent information relative to the marine weather program.

# Hurricane Alley

Dick DeAngelis
Environmental Data and Information Service, NOAA
Washington, D.C.

November and December mark the beginning of the active tropical-cyclone season in the Southern Hemisphere and the tailend of the North Indian Ocean season.

## NORTH INDIAN OCEAN
## NOVEMBER AND DECEMBER

The season finished with a bang as two vicious hurricanes plagued the seas around India in November. The first storm (fig. 28) was restricted to the Arabian Sea. It reached hurricane intensity on the 7th and remained at that level until the 10th. Maximum winds climbed to around 90 kn on the 8th and 9th (fig. 29). The storm made landfall just north of the Gulf of Kotch, near the India-Pakistan border on the 11th.

A few days later a storm developed among the Nicobar Islands. After meandering for a time, it organized and headed westward. It was a tropical storm by the 20th and reached hurricane strength the following day (fig. 30). Early on the 23d winds near its center were screaming at 110 kn. The center was just 100 mi east

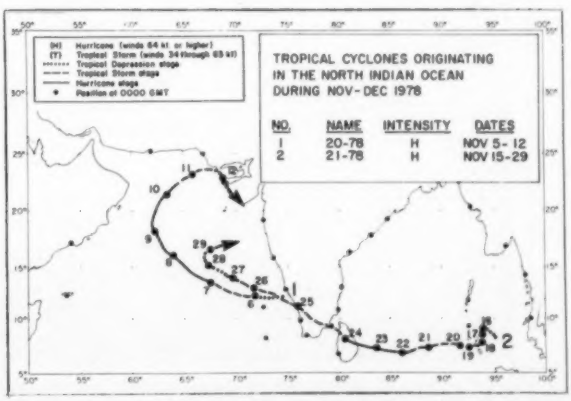

TROPICAL CYCLONES ORIGINATING
IN THE NORTH INDIAN OCEAN
DURING NOV-DEC 1978
NO. NAME INTENSITY DATES
1 20-78 H NOV 5-12
2 21-78 H NOV 15-29

Figure 28.--Tracks of November 1978 Indian Ocean tropical cyclones.

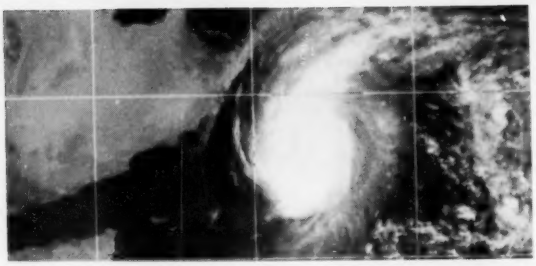


Figure 29.--Arabian Sea storm reaches peak intensity on November 8.

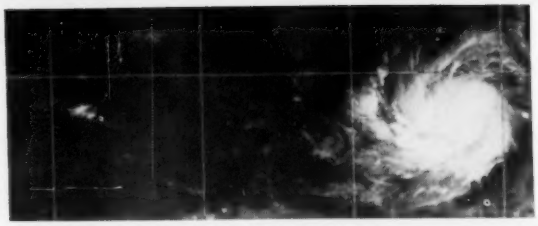


Figure 30.--Two days before Sri Lanka was blasted, this Bay of Bengal tropical cyclone reaches hurricane intensity on November 21.

of Sri Lanka. Later that day the severe cyclone swept inland with 60-kn winds battering the east coast of the island once known as Ceylon. Destruction was severe. Some 373 people were killed and about 80,000 houses were destroyed or damaged. In addition, 160 convicts escaped when the roof blew off the jail in Batticaba.

Total damage was estimated at about $50 million, most of which was caused by high winds, flooding, and landslides. Seas inundated ricelands up to 5 mi inland. The storm weakened as it made the jump across the Gulf of Mannar to India, where it was responsible for 10 deaths. On the 25th the storm was out over the Arabian Sea, but it could not regain its intensity.

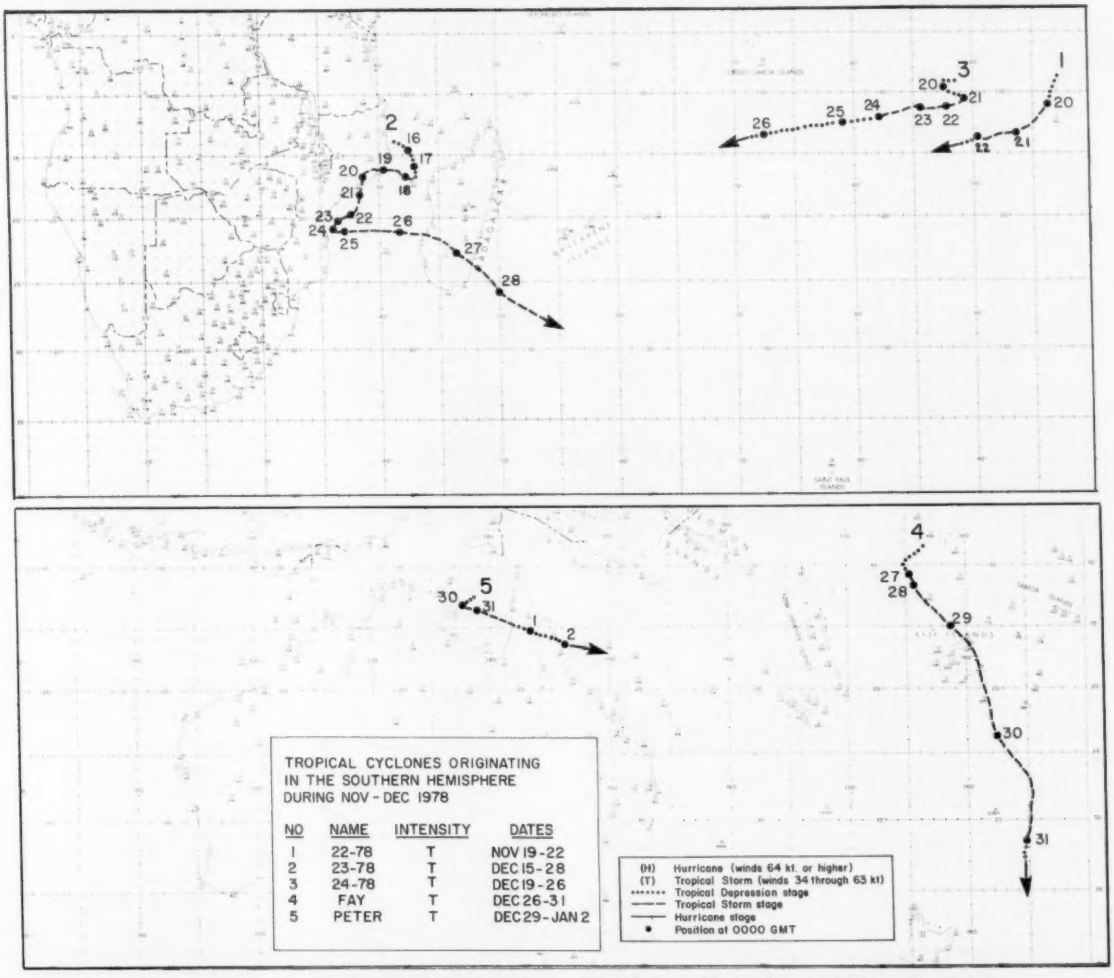

TROPICAL CYCLONES ORIGINATING
IN THE SOUTHERN HEMISPHERE
DURING NOV - DEC 1978
NO NAME INTENSITY DATES
1 22-78 T NOV 19-22
2 23-78 T DEC 15-28
3 24-78 T DEC 19-26
4 FAY T DEC 26-31
5 PETER T DEC 29-JAN 2
(H) Hurricane (winds 64 kt. or higher)
(T) Tropical Storm (winds 34 through 63 kt)
Tropical Depression stage
Tropical Storm stage
Hurricane stage
Position at 0000 GMT

Figure 31.--Tracks of Southern Hemisphere tropical cyclones, November and December 1978.

## SOUTHERN HEMISPHERE
## NOVEMBER AND DECEMBER

Just one tropical cyclone roamed these waters in November (fig. 31). A short-lived tropical storm developed on the 19th. Its initial formation took place about 5 days earlier just off the southwest tip of Sumatra. The storm moved toward the southwest but lasted only until the 22d. Maximum winds were estimated at the minimal tropical-storm strength of 35 kn.

During December two tropical cyclones formed in each region of the hemisphere. In the South Indian Ocean the action was after midmonth. One storm developed on the 15th in the Mozambique Channel, while another popped up east of the Diego Garcia Islands a few days later. The Channel storm reached hurricane intensity on the 22d. Maximum winds were estimated at about 85 kn on the 23d (fig. 32) and 24th, while the center brushed the Mozambique coast. The storm lost some steam on the 25th as it headed eastward toward Madagascar. However, it survived the crossing of the island and moved out into open waters on the 27th. Meanwhile, the storm east of Diego Garcia had reached tropical-storm strength by the 21st. Winds climbed to about 40 kn that day, but from then on it was downhill. By the 26th it was all over.

Just when it looked like the South Pacific was going to get shut out for the 2-mo period, two tropical storms popped up in the last week of December. The first was spotted cruising near the Gilbert Islands on the 26th. This was the beginning of Fay. She quickly attained tropical-storm strength and headed south-southeastward. When she moved through the Fiji Islands on the 29th, sustained winds were pushing 60 kn with hurricane-force gusts. Once through the islands, Fay turned southward and accelerated. By the 31st she was weakening and becoming extratropical northeast of New Zealand.

Figure 32.--A mean Christmas present for ships traversing the Mozambique Channel on December 23.

Just two days before, on the 29th, Peter popped up in the Gulf of Carpentaria. In these relatively tight quarters it was difficult to reach full potential. However, winds near his center did climb to about 50 kn on the 31st. This was soon stopped by the Cape York Peninsula which Peter tried to hurdle later in the day. The effort took its toll though; and when he emerged in the Coral Sea on January 1, Peter had just about petered out.

## ENDLESS SUMMER FOR HURRICANE HUNTERS

Southern Hemisphere hurricanes will be probed for the first time ever by scientists from NOAA's National Hurricane and Experimental Meteorological Laboratory and Australia's Department of Science and Bureau of Meteorology (fig. 33).

Figure 33.--A WP-3D Orion research aircraft flew hurricane research missions off the coasts of Australia in March in a unique study of Southern Hemisphere hurricanes.

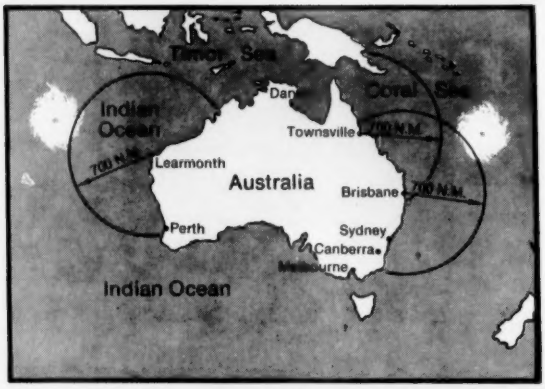



Figure 34.--The research plane operates primarily from Townsville, with secondary bases at Brisbane, Darwin, and Learmonth.

The research flights (fig. 34) are being made by one of NOAA's heavily instrumented research aircraft. This joint effort will enable Australian scientists and aircrews to develop techniques of airborne hurricane research and obtain data on the structure of southern storms for comparison with that already available for Atlantic and North Pacific hurricanes.

The Australians do not have an equivalent of U.S. hurricane reconnaissance flights by Air Force and NOAA aircraft. They depend mainly on satellite information to warn them of approaching storms, so this effort also provides an opportunity for their meterologists to use data collected in these storms for real-time forecasts and warnings.

The current mission, in which no seeding of the big storms will be attempted, could also be a precursor to a cooperative U.S.-Australia effort involving Project Stormfury, NOAA's experimental attempt to reduce hurricane winds through cloud seeding. A joint experiment with Australia has been under discussion and could be beneficial to both countries. For the United States, it would mean the opportunity to continue our experiments during the northern winter, which coincides with the Australian summer and hurricane season. For the Australians, it would mean a greatly improved understanding of storms in this region and the possibility of developing the techniques to reduce their destructive power.

# On the Editor's Desk

MORE ON TOWING ICEBERGS

The idea of towing icebergs across thousands of miles of ocean to provide water for desert areas--often greeted with a chuckle since it was first thought up in the 1850's--is close to becoming a reality. A 12-member international team is studying the possibility of using icebergs to help the world's arid regions, and an experiment in towing icebergs will be launched this spring by an Australian ship.

Success or failure of such a venture apparently depends upon knowledge of the ocean currents. Large icebergs cannot be moved at much more than .5 kn (about 3,000 ft an hr); but if the current is moving at .5 kn, the speed can be doubled by moving with it. Moving against the current is impossible. Space satellites are being used to study currents both by photographing drifting icebergs and by relaying signals from drifting ice and buoys.

The first attempt to tow an iceberg will be aimed at Australia, which has large areas of desert and is close to the Antarctic. Proximity also makes parts of Chile, Argentina, and southern Africa possible users of water from Antarctic ice. Saudi Arabia has shown interest in this water source for their drought-plagued land and was instrumental in getting international study efforts underway through the "Icebergs For the Future" group headquartered in Paris. Saudi Arabia sponsored an international conference in iceberg technology 2 yr ago in Ames, Iowa.

The first problem in such a venture is locating a source of icebergs suitable for towing. Tabular or large, flat bergs are necessary to avoid the danger of an iceberg rolling over on the ship. Tabular icebergs, rare in the Arctic, are common in Antarctica where they break off from large ice shelves that fringe the continent. Eighty percent of the world's fresh water is contained in that ice cap, which is formed from snowfall.

The next problem, according to experts, is moving such a large bulk. Many ideas have been proposed and await testing. These range from use of conventional tugboats or nuclear supertugs to electrically driven propellers mounted directly on the iceberg and powered by floating powerplants. Scientists have even considered using the difference in salinity in the iceberg and seawater--the seawater heavier--to power the berg, but are not certain how this would work.

Conventional tugs have been used in the North Atlantic to tow icebergs heading toward oil rigs, but only for short distances.

Once a suitable iceberg is located and taken in tow, then comes the problem of the iceberg melting as it passes through warm waters. For example, if an iceberg 2,700 $m^2$ and 250 m thick were towed from Antarctica to Australia, the iceberg on arrival would be 130 m thick and 2,460 $m^2$.

This amounts to 207 billion gal of ice, which would be worth $5.5 million--one-tenth the cost of this much desalinated seawater. It is estimated that operating the tug for the 12-day trip to the Antarctic and the 250-day trip back would cost $1 million. The distance is about 2,100 mi. The intransit melting, although significant, is not prohibitive.

For long trips, Saudi Arabia for instance, ideas to insulate icebergs against melting have been put forth. The most common is covering the bottom and sides of the berg with a plastic sheet, using meltwater trapped between iceberg and covering as the insulation.

ICE OPERATIONS CENTER TO BE BUILT IN NEWFOUNDLAND

A $50 million ice operations research center concentrating on cold water and icebreaking vessel research is to be constructed at Memorial University,

St. John's, Newfoundland. The center is being established under the auspices of the Canadian National Research Council and is scheduled for completion in 1980.

The Center will conduct extensive research to improve the design of icebreaking craft and offshore oil structures to assure safe and efficient operation in the cold waters of Newfoundland and Labrador.

## 1978-79 WINTER WEATHER HIGHLIGHTS

The message below contains a summary of the nation's weather highlights for the winter of 1978-79.

THE WINTER OF 1978/79 WILL GO DOWN IN THE RECORD BOOKS AS ONE OF THE COLDEST AND SNOWIEST FOR MANY SECTIONS OF THE U.S. IT HAS BEEN THE COLDEST WINTER ON RECORD FROM THE NORTHERN ROCKIES ACROSS THE CENTRAL PLAINS EASTWARD TO THE MIDWESTERN STATES. MANY OF THESE PREVIOUS RECORDS HAD BEEN ESTABLISHED ONLY ONE YEAR AGO.

THE COLD WAS PROLONGED...EVIDENCED BY THE FACT THAT FOUR OF THE FIVE GREAT LAKES WERE NEARLY 100 PERCENT ICE COVERED FOR THE FIRST TIME IN MANY YEARS. ALSO SNOW THAT CAME STAYED...NEW RECORDS WERE SET FOR CONSECUTIVE DAYS OF SNOW COVERED GROUND FROM MONTANA THROUGH THE NORTHERN PLAINS EASTWARD TO WISCONSIN AND ILLINOIS.

GREAT FALLS MT HAD 110 DAYS IN A ROW OF SNOW COVER. AT MISSOULA MT IT WAS 102 DAYS AND STILL GOING AT THE END OF FEBRUARY. HAVRE MT WAS STILL SNOW COVERED AFTER 112 DAYS...BILLINGS MT 120 DAYS.

RECORD SNOW MADE HEADLINES IN THE CHICAGO AREA. AT THE END OF FEBRUARY 87.4 INCHES OF SNOW HAD FALLEN WITH SNOW ON THE GROUND FOR 94 CONSECUTIVE DAYS...ALSO A NEW RECORD...AND STILL 10 INCHES REMAIN ON THE GROUND.

IN THE SOUTH...AND STRETCHING NORTHEASTWARD TO THE MIDDLE ATLANTIC STATES IT WAS RECORD BREAKING PRECIPITATION. JACKSON MS HAD 30.82 INCHES OF PRECIPITATION...A RECORD FOR ANY THREE MONTH PERIOD THERE. NEW YORK CITY ACCUMULATED 20.66 INCHES ECLIPSING A MARK THAT HAD STOOD NEARLY 60 YEARS.

THE EARLY PART OF THE WINTER WAS EXTREMELY COLD IN THE WEST BUT RELATIVELY MILD IN THE EAST. IN FEBRUARY THE PATTERN REVERSED SOMEWHAT WITH IT MILD IN THE WEST AND COLD IN THE EAST. MEANTIME THE MIDSECTION OF THE NATION WAS JUST COLD...COLD...COLD. IT WAS THE COLDEST WINTER EVER IN ROCKFORD AND SPRINGFIELD IL... ROCHESTER AND INTERNATIONAL FALLS MN...SIOUX CITY AND DUBUQUE IA ...SIOUX FALLS AND RAPID CITY SD...OMAHA GRAND ISLAND AND NORTH PLATTE NE...KANSAS CITY MO...TOPEKA AND WICHITA KS...OKLAHOMA CITY OK...HELENA MT. IN OREGON PORTLAND...PENDLETON...EUGENE... AND SALEM HAD THE COLDEST NOVEMBER THROUGH JANUARY IN 50 YEARS OR MORE.

ONE OF THE MOST UNUSUAL FEATURES OF THE WINTER IS THAT ABOVE NORMAL TEMPERATURES WERE ALMOST ENTIRELY ABSENT FROM THE CONTIGUOUS 48 STATES. DURING THE SPECTACULAR WINTER OF 77/78 MOST OF THE AREA WEST OF THE ROCKIES WAS WARMER THAN NORMAL... BY SEVERAL DEGREES. THIS WINTER...FROM PRELIMINARY DATA...WE COULD ONLY FIND CARIBOU ME AND EL PASO TX ABOVE NORMAL BUT ONLY BY ABOUT ONE DEGREE. BY CONTRAST A LARGE AREA FROM ILLINOIS WESTWARD ACROSS MISSOURI AND KANSAS NORTHWEST TO WYOMING AND MONTANA AND NORTHWARD TO THE CANADIAN BORDER ENDURED TEMPERATURES 8 OR MORE DEGREES BELOW NORMAL. SHERIDAN WY WAS 13 DEGREES BELOW NORMAL AND NORTH PLATTE NE 12 DEGREES BELOW NORMAL.

FINDING A COMFORTABLE CLIMATE LAST WINTER WAS INDEED A DIFFICULT ASSIGNMENT. EVEN THE TROPICS HAD THEIR PROBLEMS. PARTS OF THE HAWAIIAN ISLANDS WERE FREQUENTLY DRENCHED WITH TORRENTIAL RAINS AND FLOODING.

FRED OSTBY
NATIONAL SEVERE STORMS FORECAST CENTER

## MESSAGE CROSSES OCEAN IN 3 YR

About 3 years ago, Helge Holcomb and Lewis Flax, two Ocean City teenagers, threw a bottle into the Atlantic Ocean off an amusement pier. They stuffed the bottle with a message and a small American flag. It turned up almost 3,000 mi away this summer.

Recently, the teenagers learned that the bottle had washed ashore in the Azores, 740 mi west of Portugal in the Atlantic. They received a letter from Jose Santosalves of the Azores.

## AIMS ANNOUNCES SAFETY AT SEA CONTEST

The American Institute of Merchant Shipping (AIMS) has opened its 1979 contests for achievement in safety at sea--the Ship Safety Achievement and Jones F. Devlin Awards. Fliers for each contest, which cover safety achievements in calendar year 1978, have been mailed to about 200 chief executives and safety directors of American-flag steamship companies.

The Ship Safety Achievement Awards are sponsored by AIMS and the Marine Section of the National Safety Council and are conferred on vessels representing all segments of the American-flag merchant marine who have performed outstanding feats of rescue or seamanship illustrative of the high safety standards in the nation's fleet.

The Jones F. Devlin Awards, also sponsored by AIMS, are given to any American-flag ship which operates for 2 consecutive yr without a crewmember losing a full turn at watch because of an occupational injury. Higher honors go to vessels completing 4 accident-free yr, and there are special awards for exceptional records. Devlin Award entries will be accepted through April 20, 1979.

Entries should be sent to Barbara D. Burke, Director, Public and Legislative Affairs, American Institute of Merchant Shipping, 1625 K. Street, NW, Suite 1000, Washington, D.C. 20006.

## WELLAND CANAL MARKS 150TH ANNIVERSARY

A number of ceremonies marking the 150th anniversary of the opening of the first Welland Canal will be held in 1979, with Canadian and Great Lakes shipping leaders now planning various events, according to an announcement from St. Catherines, Ontario.

The 25-mi-long shipping artery, linking Lakes Erie and Ontario, is the fourth built since the original waterway was opened to traffic in November 1829. The present waterway, under Canada's St. Lawrence Seaway Authority, is a vital link in the Seaway system, which provides access to the U.S. and Canadian Midwest for ocean shipping.

## NOAA HAILS ARK

NOAA presented a Special Service Award to Chief Marine Science Technician Walter P. Ark on November 28, 1978, at 9th District Headquarters, Cleveland, Ohio.

MSTC Ark was commended for assistance he rendered to the National Weather Service. He visited all 38 weather-reporting stations on the Great Lakes to coordinate weather and ice reporting procedures for the upcoming winter season.

## HALLGREN NAMED TO HEAD WEATHER SERVICE

Dr. Richard E. Hallgren has been named Director of the National Weather Service.

Hallgren, former Acting Assistant Administrator of NOAA for Oceanic and Atmospheric Services, succeeds Dr. George P. Cressman, who has resigned to devote full time to research with the National Weather Service.

Hallgren, recipient of numerous scientific honors, is internationally known as a major contributor to global weather programs and nationally known as an innovator of concepts and systems designed to speed the acquisition, processing, and dissemination of weather information.

He was born in Kersey, Pa., and graduated from Pennsylvania State University in 1953 with a B.S. in meteorology. After 2 yr as an Air Force weather of-

ficer, he returned to the University to earn a Ph.D. in meteorology in 1960.

That same year Hallgren joined IBM Corporation, where he was a research analyst and then manager of the IBM Meteorological Systems Department. In 1964 he was appointed Scientific Advisor to the Department of Commerce Assistant Secretary for Science and Technology, and 2 yr later became the first director of the Office of World Weather Systems within NOAA's predecessor, ESSA.

From 1969 to 1971, he was Assistant Administrator for Environmental Systems, becoming Associate Administrator in September 1971. He was also the Federal Coordinator for Meteorological Services and Supporting Research during 1972-73. In March 1973 Hallgren was appointed Deputy Director of National Weather Service. He became Acting Assistant Administrator of NOAA for Oceanic and Atmospheric Services in November 1977.

Hallgren was one of the 1968 winners of the Arthur S. Flemming Awards for outstanding young men in the Federal Government, and in 1969 he won a Department of Commerce Gold Medal. He is a member of Sigma Xi, the American Meteorological Society, and the American Oceanic Organization.

Over the years he has taken an active part in the development of the World Weather Watch of the World Meteorological Organization, which led directly to his participation in the planning for the Global Atmospheric Research Program's (GARP) Atlantic Tropical Experiment (GATE) in the summer of 1975.

The position of Acting Assistant Administrator for Oceanic and Atmospheric Services will be assumed by David S. Johnson, Director of NOAA's National Environmental Satellite Service.

## DIVERS TO PROBE MONITOR WRECKAGE

An intensive underwater archaeological investigation of the remains of the Civil War ironclad U.S.S. MONITOR, lying in 210 ft of water 16 mi off the coast of North Carolina, will be conducted this summer (fig. 35).

Using some of the most sophisticated diving and underwater archaeological equipment ever used on any wreck in U.S. waters, scientists will make more than 30 dives on the historic remains during 3 weeks in August. NOAA and the Harbor Branch Foundation, Inc., a Florida-based underwater oceanographic research organization, have signed an agreement for Harbor Branch divers to photograph and video tape the wreck, test it for structural integrity, and establish a series of control points around it for archaeological reference.

Although it is far too soon to decide whether or not the MONITOR can be raised safely, the expedition will provide valuable additional information to help make that decision. Since its discovery in 1973, MONITOR has been the object of scientific and public fascination. The most useful information to date regarding the MONITOR's condition has come from pictures taken in August 1977. These showed the wreck lying upside down with its famous "cheesebox" armored turret detached and half buried in the Atlantic sand. In that series of dives onto the remains a signal lantern believed to have been carried on the MONITOR's deck the night the ship sank while under tow in 1862 was recovered. A 65-lb piece of hull plating was also brought to the surface.

Figure 35. -- The location of the MONITOR.

During this summer's expedition attempts will be made to recover any additional artifacts from the forward part of the vessel. Specially designed containers are being made by the North Carolina Department of Cultural Resources to stabilize and preserve any artifacts recovered until they can be transported to a conservation laboratory.

## FOUR SAVED AFTER 5 DAYS IN LIFERAFT

Four survivors who floated for 5 days in a liferaft after their crab boat sank on New Year's Day in the icy, storm-churned Gulf of Alaska were rescued on January 5 by the Crowley Maritime tug STALWART. The sunken boat was the 80-ft OCEAN CAPE.

The STALWART's skipper radioed that all suffered fatigue, cold, and hunger, and one man had a broken or sprained ankle. Their survival suits and the sheltered liferaft probably saved them.

The Coast Guard said the rescue was made about 250 mi southwest of Whittier, Alaska, in predawn darkness. The OCEAN CAPE was bound for Yakutat with snow crab aboard and probably capsized before a call for help could be radioed. It is believed that the covered raft was equipped with a high-intensity strobe flasher visible in darkness.

It was a miracle that the tug spotted them and another that it was able to pick them up. The STALWART packs 9,000 hp, but she was dragging 800 ft of barges carrying loaded railcars. A burdened vessel just does not have maneuvering ability in stormy seas to go alongside a liferaft.

## NEW ICEBREAKING TUG COMMISSIONED

The U.S. Coast Guard commissioned its new 140-ft icebreaking tug KATMAI BAY on January 8, 1979,

Figure 36.--The new Coast Guard icebreaker appears to sit low in the water in this profile view. U.S. Coast Guard Photo by Steve Tiggemann.

during ceremonies at Cleveland's Navy Reserve Center. Over 200 guests watched as the tug's new captain, Lieutenant Commander Richard D. White, accepted command after she was placed in commission by the Coast Guard Commandant, Admiral John B. Hayes.

KATMAI BAY (fig. 36), the first new Coast Guard cutter to come into service specifically for duty on the Great Lakes since 1944, is bigger, faster, and more powerful than the 110-ft tugs she will replace. Four more "sister ships" will follow in her footsteps by winter of 1979-80. KATMAI BAY will be homeported in Sault Ste. Marie, Mich., where she will be tasked with icebreaking and search-and-rescue missions.

Using a unique bubbler system, which lubricates her hull during icebreaking operations, KATMAI BAY is designed to move continuously through 18 to 20 in of fresh-water ice, a 50-percent increase over the 110-ft tug's icebreaking capability. Her cruising range of 4,000 mi will enable her to search farther and remain longer in a search area than the 110 footers.

KATMAI BAY is designed for greater crew comfort than her older counterparts. All living areas are above the main deck and air conditioned and humidified year-round. The pilothouse and engineering control areas are also climate controlled. The KATMAI BAY's larger external dimensions over the older 110's allow for more spacious dining and berthing areas for the 17-man crew.

The KATMAI BAY, as the first of her class, is the product of many hard-fought battles, both on the design board and in the halls of government. Together with her sister ships, the Coast Guard hopes that she will significantly improve icebreaking capability and the facilitation of commerce on the Great Lakes.

## NTSB RECOMMENDS TIGHTER SAFETY STANDARDS FOR STEERING SYSTEMS

Tighter safety standards for steering systems on all vessels entering U.S. ports have been recommended by the National Transportation Safety Board (NTSB).

The Board made seven safety recommendations in its report on a July 28, 1977, accident on the Mississippi River at New Orleans in which the 84,000-ton French tanker SITALA carrying crude oil crashed into

a berthed fleet of barges. The SITALA's rudder was immobilized by lack of hydraulic pressure in the steering control system. There were no fatalities or injuries in the accident, but 5 barges were sunk and 15 other vessels were damaged. Total property damage was estimated at $1.5 million.

The Safety Board held that the steering gear of the tanker failed as a result of inadequate maintenance and inspection of the steering gear by the ship's crew, which permitted leaks in the steering system to reduce the hydraulic oil level in the single hydraulic reservoir until discharge pressure was lost from the hydraulic charge pumps to the control mechanism.

Contributing to the cause, the Board said, were the inadequate inspection of the steering gear by a classification society surveyor on July 26, 1977, and the design of the steering gear which utilized a single control path to the steering gear power units.

Joint investigation of the accident by the Safety Board and the U.S. Coast Guard showed that the surveyor--an inspector from a nongovernment marine inspection organization used by the tanker's owner--had seen steering system hydraulic leaks for which drip cans had to be used. He was also aware that a drum of hydraulic fluid had been lashed to the steerage machinery and a hand pump rigged to permit crewmen to replenish the hydraulic reservoir from the drum.

Investigators also found that the SITALA's steering system failure alarm would not activate unless there was an electrical power failure and that the improved steering system standards proposed by the Coast Guard and the Inter-Governmental Maritime Consultative Organization (IMCO) would not have prevented the New Orleans accident.

Among the goals of the Safety Board's safety recommendations, all addressed to the Coast Guard, are:

- Steering standards for all seagoing vessels entering U.S. waters which reduce the time allowed for alarms to alert a crew of a system failure, and to restore steering control.

- Require steering gear test devices which show whether operation is normal.

- An expanded program for boarding foreign vessels to inspect steering gear and determine the adequacy of its maintenance.

- Expanded U.S. efforts, through IMCO, toward more comprehensive and uniform annual inspections of all types of vessels rather than tankers only.

## CLEVELAND PMO RECEIVES BRONZE MEDAL

Mr. William (Bill) Kennedy, Port Meteorological Officer, Cleveland, Ohio, has been awarded the Department of Commerce Bronze Medal for his outstanding achievements in developing the Marine Data Acquisition Program on the Great Lakes (fig. 37).

Twenty of Bill's 36 yr of government service have been as a marine assistant (Port Meteorological Officer) in Cleveland. Through his initiative and the cooperation of marine interests, a sound and effective marine observation program was developed. Over the last 20 yr he has constantly improved this program.

As a PMO he knows the importance which the Captains and Mates place on weather, and he has continually done his best to provide them with the best possible service. The International Ship Masters Association recognized Bill's 25 yr of service to the Great Lakes marine community in 1978 by making him an honorary life member.

Figure 37.--Mr. William (Bill) Kennedy, the Port Meteorological Officer, Cleveland, Ohio.

## BUOY FROM STATION 41001 MISSING

Buoy-positioning data received on January 23, 1979, indicated that buoy 12D7 had broken its mooring and drifted 30 mi east of station 41001. By the 24th the buoy was farther to the east. On January 28 the Coast Guard cutter MADRONA located the buoy and was standing by waiting for the weather to moderate sufficiently to take the buoy in tow. During that period, the MADRONA suffered damage due to heavy seas.

The Coast Guard cutter INGHAM was ordered to the scene on January 29 to relieve the MADRONA. Enroute to port the MADRONA suffered additional damage, and the INGHAM was diverted to provide assistance to the MADRONA. By February 1 the MADRONA's problems were under control, and the INGHAM was further diverted to assist a distressed sailboat. The INGHAM then proceeded to Bermuda to refuel prior to returning to the buoy. In the meantime, all transmissions from buoy 12D7 had ceased. The last reported position on February 1 was 34°42'N, 64°06'W. The simultaneous cessation of two independent transmission systems is a strong indicator of some form of catastrophic failure. On February 4 the INGHAM departed Bermuda and commenced search for the buoy, but the search was terminated on the 6th with unsuccessful results.

United States Department of Commerce

National Oceanic and Atmospheric Administration

SPECIAL SERVICE AWARD

*Presented to*

**GALVESTON**

CITATION
For timely and accurate weather observations while employed in the Alaskan trade.

*in recognition and appreciation of Significant Services rendered for the National Weather Service*

Robert W. Shows
Marine Observation Program Leader

Figure 38.--The Special Service Award.

GALVESTON RECEIVES SPECIAL SERVICE AWARD

A special service award (fig. 38) was presented to Captain William Bentley, Jr., captain of the SS GALVESTON on December 4, 1978, at the Sea-Land offices in Seattle, Wash. (fig. 39).

The SS GALVESTON has been on the Seattle to Anchorage run for over 7 yr and during this time has provided the Weather Service excellent weather observations. The GALVESTON departed on December 4 for Japan where the ship will be assigned to shuttle service in the Far East.

The SS GALVESTON's KGBA weather observations from the Gulf of Alaska will be missed by many forecasters in the Seattle area.

Figure 39.--Donald Olson, PMO Seattle, presents the award to Captain Bentley.

DECEMBER SNOWCOVER SETS NORTH AMERICAN RECORD

NOAA satellite measurements indicate that snow covered a greater portion of North America in December 1978 than during any previous December for the past 13 yr. Snow, chiefly in the West and Midwest, extended as far south as northern Mexico.

Satellite imagery from NOAA's two satellite systems, one geostationary and one polar-orbiting, showed that during December 1978 an average of 6.3 million $mi^2$ of North America was covered by snow (fig. 40). The previous record for December was set in 1972 when 6.2 million $mi^2$ of coverage was recorded. The studies also showed that 58 percent of the United States had snowcover at one time or another during December 1978.

Analysis of snowcover from satellite data began in 1966. The 10-yr mean December snowcover of North America is 5.8 million $mi^2$, 9 percent less than that of December 1978.

Comparing December 1978 North American snowcover with the same month in 1977--the beginning of a record-shattering winter in the eastern United States--December 1978 snowcover was 8.6 percent greater. Record snowcover in December does not necessarily mean that the rest of the winter will see a record extent of snow.

In Eurasia, despite record cold in Moscow and unusual snow in the British Isles and western Europe, satellite images registered a drop of about 4 percent from December 1977 mean snowcover, but still just slightly above the 10-yr December mean for Eurasia.

Figure 40.--Map showing the maximum snowcover for December 1978.

EAST COAST SINKINGS CLAIM SEVEN LIVES

At least seven East Coast watermen lost their lives in a series of capsizings during a 2-week period from late November to mid-December 1978.

One incident occurred on December 10 about 23 mi southwest of Chincoteague, Va., where a northwest gale with subfreezing temperatures overwhelmed the 101-ft scallop boat RENDEVOUS. Four of 12 men on board died; the other 8 were rescued from two liferafts by Coast Guard helicopters.

At 4:30 a.m. the RENDEVOUS had radioed that a porthole had broken, the boat was sinking, and the crew was abandoning the vessel aboard liferafts. The helicopters located the rafts about 6 a.m. and flew the survivors to the NASA Hospital on Wallops Island for treatment of hypothermia and exposure. They reported that the boat had gone down in 20-ft seas amid wind gusts to 75 kn.

Bodies of the four victims were recovered by the cutter INGHAM less than 3 hr after the sinking. Coast Guardsmen aboard the INGHAM attempted unsuccessfully to revive the victims.

The Cape May Coast Guard Station reported that when rescuers reached the scene, the wind chill factor was below zero, with 12-ft seas and 40-kn winds.

One crewman died and another is presumed drowned in a capsizing that occurred on November 30, when the 44-ft tug HALL BROTHERS, bound for Quonset, R.I., from Boston, radioed the Coast Guard that she was sinking fast off Breton Reef near Narragansett Bay.

A search located the tug in about 60 ft of water just south of Sakonnet Point in Little Compton, R.I. The body of one of the crewmen washed ashore near Chillmark, but there was no trace of the other. A buoy marking nearby Schuyler Ledge was damaged, but the Coast Guard reported that there is no way of determining immediately if the HALL BROTHERS had collided with the buoy.

A third boat sank in heavy weather on December 2. She was the 61-ft fishing vessel ROSIE, which went down 14 mi south of Monhegan Island, Me. One crewman was picked up by the Cundy Harbor trawler GOLDEN DAWN. The second crewman was presumed drowned, after the Coast Guard abandoned search less than 3 hr after it began. The rescued crewman was wearing a lifejacket and clinging to a large gas cylinder. He said that the boat sank 3 min after they radioed a distress call. The ROSIE was on her way back to port after fishing more than 20 mi south of Monhegan.

Two men may have died in late November about 6 mi south of the Newport, R.I., Brenton Reef radio tower at the mouth of Narragansett Bay. The Castle Hill Coast Guard station in Newport received a distress call at 8:15 p.m. and immediately launched a search by air and sea, but they failed to turn up either vessel or crewmen.

In another incident the 3-man crew of the Long Island, N.Y., fishing boat ROBERT E was rescued before the vessel sank on December 3. The 100-ft wooden converted submarine chaser sank 10 mi south of Montauk Point, L.I., when 6-ft waves churned by high winds knocked loose a bow plank. The crew was rescued by the lobsterboat SPARTAN.

One day earlier, a 65-ft fishing boat sank without apparent cause 27 mi southeast of Block Island, N.Y. All five men aboard the Sakonnet Point, R.I., vessel UNITED STATES were rescued by the Coast Guard cutter DECISIVE. All of the men were wearing survival suits.

## OCEAN CLIMATE STUDY BEGINS IN EQUATORIAL PACIFIC

NOAA has begun the first major study of how Pacific Ocean waters reflect changes in global climate. The Equatorial Pacific Ocean Climate Studies (fig. 41) seek to determine the driving forces behind large variations in sea-surface temperature and how these variations are linked to climatic changes.

The study is a highly focused, multiyear program of experimentation and research, which hopefully will provide useful new insights into how the "climate machine" works.

At the heart of the climate machine and the research is the relationship between the ocean and atmosphere--a kind of geophysical marriage of opposites. The atmosphere is the flamboyant, active partner with a short memory. The ocean is the stable partner, long of memory, given to hoarding energy which is squandered by the atmosphere.

One of the more energetic and variable parts of the climate machine is the equatorial Pacific, a huge and

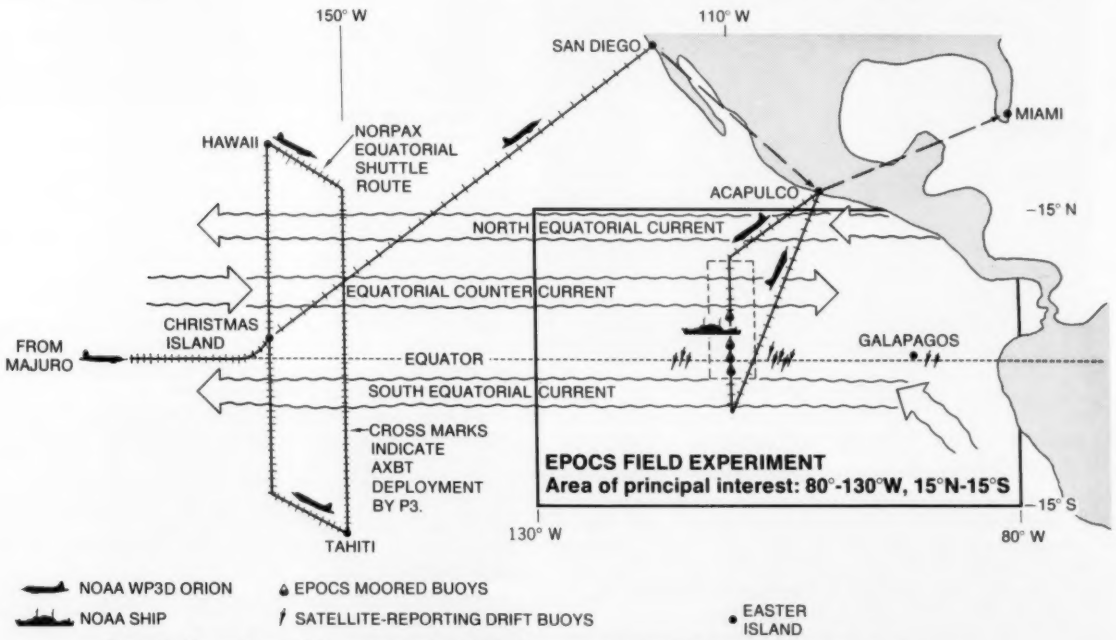



Figure 41.--A graphic portrayal of the Equatorial Pacific Ocean Climate Study.

influential source of stored heat and an enormous engine for the redistribution and release of that heat into the tropical atmosphere.

On a year-to-year basis the spatial distribution of heat released into the atmosphere appears to be associated with large sea-surface temperature anomalies in the eastern tropical Pacific. These anomalies--warmer or colder deviations from the long-term average sea-surface temperature--are quite large, amounting to several degrees Celsius over thousands of miles and perhaps 20° of latitude. Changes on that scale could influence the global atmosphere and are reflecting global-scale atmospheric changes.

The study is focusing on these temperature anomalies, the processes that cause them, and the processes they trigger in the atmosphere in an area stretching from about 150°W longitude eastward to the coast of South America and about 15° latitude north and south of the Equator.

In parallel with the field experiment, NOAA scientists are conducting intensive studies of the existing mass of data already available on the equatorial Pacific and its overlying atmosphere.

A third element in the study is a program of numerical modelling and analysis. The scientists will incorporate new data from the field experiment and other sources into existing ocean-atmosphere numerical models, with an eye to learning how the sea-surface temperature anomalies connect with atmospheric processes occurring on the time scales of climate.

## NOAA MAPS SOLAR ENERGY POTENTIAL OF U.S. REGIONS

Solar heating is just as effective in Billings, Mont., as it is in St. Louis, Mo., according to a NOAA study that maps how well (or how poorly) solar heating works across the conterminous United States.

The report, prepared by the Air Resources Laboratories in Silver Spring, Md., compares the amount of solar radiation an area receives with the heating demands of the area for the month of January and for the winter heating season of November through April. In the study increased solar radiation values resulting from solar collectors tilted southward were used.

Without judging the efficiency of different solar energy systems, the relative potential of solar heating in different regions was rated based on climatic considerations alone. Knowing the percentage of a structure's heating requirements that a given collection system can furnish at one location, energy planners and architects can use the maps (fig. 42) to estimate the percentage of solar heating available at another location for the same kind of structure and collection system.

For example, a solar collection system that could supply 30 percent of a given building's heat needs in Rochester, N.Y., would supply 60 percent of the heat needed by an identical building in Manhattan.

More southerly climes do not necessarily rate a higher rank on the solar-heating scale. Effective solar heating on the western high plains is up to twice that of the same latitudes in the Mississippi Valley, so that central Montana holds as much promise for solar energy as southern Indiana, more than 500 mi farther south. It was also found that a southward-facing collector in the northern states receives more than twice the amount of solar radiation as falls on a horizontal surface there.

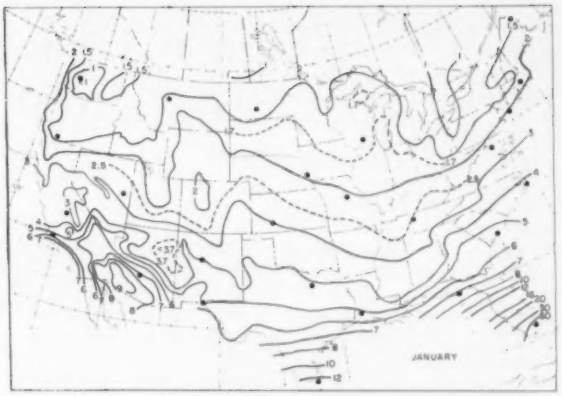



Figure 42.--A map of the relative potential of solar heating in the United States.

The region where solar energy would supply the smallest portion of needed heat is around Lake Ontario. This region was assigned an effectiveness value of 1, and the rest of the country was divided according to its effective solar heating relative to this base. Northern Texas rates a 4. This means that a given solar collector there could supply four times as much of the needed energy as it could in Rochester, N.Y. At the top of the scale is southern Florida with a January value of 60.

The study used climatological data archived at NOAA's Environmental Data and Information Service: solar-radiation measurements from 90 stations updated to 1975 and heating-degree-day records from 265 stations around the United States.

## DEEP SEA EXPLORATION OF GALAPAGOS RIFT BEGINS

The research submersible ALVIN, operated by the Woods Hole Oceanographic Institution, will take biologists, geologists, and chemists to depths of 2,500 m on the Galapagos Rift during the first 3 mo of 1979 for a second look at warm-water vents and accompanying clusters of unusual animal life discovered on dives there in 1977.

The research vessel GILLISS, operated by the University of Miami, has departed for the research area. The first objective will be to relocate the vents, using satellite navigation coordinates from the 1977 expedition, precise topographic maps supplied by the U.S. Navy, and a towed-camera system. A temperature probe mounted on the camera rig will alert the scientists to the warmer waters characteristic of the vents. By the time ALVIN and mother ship LULU arrive in the area, a transponder navigation net set on the sea floor will guide the submersible to the vents.

Ten dives are scheduled for the first leg of the research voyage, when the emphasis will be on biological research. The major effort will be a comprehensive description of the self-contained ecosystems discovered in 1977 to find out how the animals came to be there and what sustains them. Scientists theorize that the clusters of clams, mussels, crabs, and other animals thriving around the vents in a usually barren sea-floor-

scape may live on a food chain based on sulfur-oxidizing bacteria. Each of the four living-vent communities photographed 2 yr ago had its own set of organisms. They may, therefore, represent oceanic islands of unique life. The animal communities range from a few to tens of meters across.

A slurp-gun sampler has been developed for collecting both microscopic animals living in the scant sediments deposited on the rocks in the area and an organism known as a "dandelion" for its gone-to-seed appearance. The dandelions, a few centimeters in diameter, are one of the major biological mysteries of the vent communities. They had neven been seen before and proved too fragile to sample with ALVIN's mechanical arm. The scientists hope to collect samples with a collection bottle attached to a suction hose that can be placed with the arm near the organism, which appears to position itself above the sea floor on fine web-like extensions.

Extensive photography of the vents is planned for comparison with photographs taken 2 yr ago. This will give an idea of growth and change in the vent communities and also of the active time span of the vents. A fifth vent community containing only dead animals was found in 1977.

During the biology dives, the GILLISS will be traveling along the plate boundary as the scientists look for other vents in quest of a better understanding of the driving mechanism that moves the great crustal plates of the Earth. It is believed that a series of magma chambers occur deep beneath the crust at intervals along the plate spreading center, such as the Mid-Atlantic Ridge and the Galapagos Rift. They are the source of volcanic material that wells up about every 10,000 yr at any given location as the plates move apart. They are also the heat source for warming water that percolates into the rock and re-emerges as a warm vent. The 1977 vents occurred within a 3-km stretch. On this voyage they will be looking for their mirror image on the other side of the magma chamber.

They will also be looking for heavy metal deposits similar to those found at 21°N near the entrance to the Gulf of California during a French submersible program in April 1978.

This exploration will extend into early February on the second leg of the voyage, which will include as many as 10 dives on new vents that may be located. The geological and geophysical gear will then be transferred to the research vessel MELVILLE, operated by Scripps Institution of Oceanography, for additional spreading center work at 21°N during March.

The third leg of the Galapagos expedition from late February to mid-March will concentrate on the chemical aspects of the vents and spreading centers.

Funding for the expedition is provided by the National Science Foundation, the Office of Naval Research, and the National Geographic Society. National Geographic will be filming the scientific work and the animal life for the Society's magazine and for a planned television special scheduled to air in fall 1979. A very small, high-quality, solid-state television camera has been adapted for the new, second mechanical arm mounted on ALVIN. Its six-to-one (12.5 to 75 mm) zoom macrolens coupled to a display screen inside ALVIN will offer the diving scientists their first larger-than-life monitoring of the terrain and animals on the sea floor as well as extensive videotaping capability.

## 125 DEATHS, $1 BILLION DAMAGES FROM 1978 FLOODING

As the United States faces the potential for spring flooding in portions of the United States because of heavy snow cover, NOAA reports that last year floods of all kinds killed about 125 persons and caused damage in excess of $1 billion.

Flooding triggered by remnants of tropical storm Amelia last August caused what is believed to be the greatest storm in recorded history in Texas in terms of widespread heavy rainfall and runoff. Thirty-three lives were lost and damage was estimated in excess of $100 million.

A flash flood from heavy rainfall in February destroyed the hamlet of Hidden Springs in California's Angeles National Forest, killing 20 persons. This storm system also forced evacuation of 1,200 persons because of flooding and mudslides in the Los Angeles and San Joaquin Valley areas, some 50 mi to the south.

NOAA's National Weather Service lists two other $100 million floods in 1978. In December when heavy rainfall and melting snow overburdened the Arizona and New Mexico rivers, 23 persons died in the resulting floods in Arizona and New Mexico. A May flood in metropolitan New Orleans also caused damages approaching $100 million and took four lives.

Major floods occurred in every month except November, and 18 of the 24 Presidentially-declared weather-related natural disasters in 1978 were caused by floods. Other major 1978 floods are listed below.

January--Severe flooding in southwest Georgia, in Tucson, Ariz., and along the San Lorenzo River in California, with two deaths in Tucson and one in California.

February--Major flooding along the Salinas and Pajaro Rivers in California.

March--Widespread flooding along the St. Mary's and Maumee Rivers in Indiana, in the Phoenix and Flagstaff areas of Arizona, and in parts of central and eastern Nebraska caused an estimated $80 million damage with two lives lost.

April--The third highest water levels in recorded history of the Red River of the North caused flooding in North Dakota and Minnesota, taking two lives, and the worst flooding along the Roanoke River in Virginia since the record hurricane Agnes flood of 1972.

May--Urban flooding in northern Louisiana; $50 million damage and two lives lost by flooding in southeastern Montana; and $30 million damages and four deaths along Palo Duro and Tierra Blanca Creeks in Texas.

June--Parts of Big Bend National Park in Texas inundated by flood waters in Rio Grande with one death; flash floods caused almost $20 million damage in southern Michigan, New Hampshire, southwest Wisconsin, Minnesota, and Indiana.

July--Flash flooding near Fairhope, Ala.; about $60 million damage and one death in southeastern Minnesota; and $53 million damage and one death from flooding of Kickapoo River Basin in Wisconsin.

August--Five deaths from flash floods at White

Sands Missile Range in New Mexico; two deaths near Friendship, Ind.; and one death in Nelson County, Va.

September--Flash floods in Pulaski and Saline Counties in Arkansas with $25 million damage and 10 deaths; urban flooding in West Monroe, La., with $45 million damage; and Rio Grande drainage flooding and one life lost in both San Patricio and Jasper Counties in Texas.

October--Flooding continued along the Rio Grande. Five days of rain in Puerto Rico caused two deaths from flooding.

December--Major flooding in Kentucky took two lives in both Bowling Green and Lexington areas, with record river stages recorded in eastern Kentucky.

CUTTERS RESCUED BY ICEBREAKER

Sixty-one Coastguardsmen survived crushing Lake Michigan ice jams on January 14, 1979, when the 180-ft ACACIA and the 110-ft ARUNDEL were freed after being trapped together off the coast of Washington Island by ice that threatened to topple the ARUNDEL.

The 20 crewmembers of the ARUNDEL abandoned ship and marched 300 yd across the frozen lake to the comparative safety of the ACACIA, which although stranded was in no immediate danger of sinking. The two crews huddled together for 13 hr until the ACACIA freed herself, and with the help of the 230-ft Coast Guard icebreaker MACKINAW salvaged the ARUNDEL.

This sea drama ended after the ARUNDEL was reboarded by her crew on January 14 and brought back to life. The two cutters had begun their twin mission on the 12th. They were escorting the 1,000-ft ore carrier EDWIN GOTT from Sturgeon Bay through the 18-in-thick ice of Green Bay. The GOTT was on her maiden voyage bound for Milwaukee.

Cutting through the ice at only about 1 mi/h, the cutters, with assistance from another cutter, the RARITAN, successfully led the GOTT through the Rock Island Passage from Green Bay to the open Lake. As the RARITAN departed, the other two cutters received a request from two freighters about 10 mi away, the AMOCO ILLINOIS and the JUPITER, to break ice for them. The two cutters reached the freighters and within several hours managed to break a path. Then another freighter, the WILFRED SYKES, requested assistance in reaching Escanaba.

The two cutters were breaking ice within 600 yd of the SYKES when the ARUNDEL became wedged in a windrow--a ridge of ice--and ice began to overrun the stern deck. When the ARUNDEL began to list, the decision was made to abandon the vessel. With the ACACIA spotlights on the floundering ARUNDEL, the ARUNDEL crewmembers, linked by ropes, were led by three ACACIA sailors across the ice.

At the time of evacuation, winds were estimated at 45 mi/h, and snow and frigid temperatures combined to make operations difficult. Over the next several hours, the strong winds began forcing the two ice-embedded ships toward Fishermen Shoal near Washington Island. The ships had drifted to within 4,000 yd of the shoal and were moving toward it about 5 mi/h. About 4 a.m. on the 14th, the ACACIA was able to free its rudder and moved alongside the ARUNDEL. A line was attached, and the ACACIA attempted to tow the ARUNDEL clear. Shortly before the MACKINAW arrived, the ACACIA freed the ARUNDEL from the ice on a second attempt.

# MARINE WEATHER REVIEW

The Smooth Log (complete with cyclone tracks, climatological data from U.S. Ocean Buoys, and gale and wave tables) is a definitive report on average monthly weather systems, the primary storms which affected marine areas, and late-reported ship casualties for 2 mo. The Rough Log is a preliminary account of the weather for 2 more recent months, prepared as soon as the necessary meteorological analyses and other data become available. For both Smooth and Rough Logs, storms are discussed during the month in which they first developed. Unless stated otherwise, all winds are sustained winds and not wind gusts.

## Smooth Log, North Atlantic Weather

### September and October 1978

SMOOTH LOG, SEPTEMBER 1978--The major storm track across the North Atlantic was near the climatological mean. Climatology indicates two tracks passing over Newfoundland, with the northern one continuing to Iceland and the southern one to the Faeroe Islands. This month the mean track would follow a course between the two except off the Labrador Sea. In this western area a track came east out of Labrador and another northeastward from Newfoundland. The paths of storms leading to the salt water were vastly different from climatology. The storms mostly originated over the eastern slopes of the Rocky Mountains of southern Canada and northern United States and tracked eastward. Climatology indicates a northeastern track out of the United States and off the East Coast. No storms formed off the East Coast this

month.

As usual, the most prominent feature in the mean pressure pattern was the Azores High. The significant feature of this HIGH this month was its 1025-mb center, which was displaced over 700 mi to the northeast of its climatic position. The center was near 43°N, 19°W, and 4 mb higher in pressure than normal.

The 1003-mb Icelandic Low was near 61°N, 26°W, only a relatively few miles from the normal position and 2 mb lower in pressure. There was an anomalous 1004-mb LOW over the Gulf of Bothnia. The pressure along the east coast of North America was near normal.

The most significant anomaly center was plus 8 mb near 47°N, 10°W, associated with the Azores High. This center particularly influenced the area bounded by 40° to 60°N and 30°W to 10°E. The largest negative anomaly center was minus 8 mb over the Gulf of Finland. Over the open ocean the largest negative anomaly was 4 mb south of Kap Farvel near 53°N, 47°W.

In the upper air at 700 mb the long-wave trough was alined along longitude 57°W and much sharper than normal. There was a ridge over the west coast of Europe, rather than the usual short-wave trough.

There were three tropical cyclones--hurricanes Flossie and Greta and tropical storm Hope. The annual article describing the tropical cyclones of 1978 appears on page 76.

Extratropical Cyclones--There were several significant storms this month along the northern shipping lanes. The first of these formed over James Bay on the 4th. It moved east-southeastward and crossed into the open water over Cabot Strait following behind hurricane Ella.

By the 7th the LOW was 986 mb near 50°N, 43°W, at 0000. Ocean Weather Station Charlie had 18-ft waves. By 1200 this LOW had absorbed what remained of the circulation of Ella. The German fishing vessel TEUTONIA was near 62°N, 40°W, with winds exceeding 50 kn out of the north. She did not report the seas. To the south of the 978-mb LOW (1200 analysis) a SHIP was battered by 30-ft swells. Ahead of the storm Lima measured 18-ft swells. The 1800 report of the ATLANTIC CONVEYOR (47°N, 39°W) indicated westerly winds of 78 kn, but no wave reports.

The C. P. DISCOVERER found 54-kn westerly winds near 52°N, 30°W, at 0000 on the 8th. This was about 350 mi south of the storm's center. The waves were 20 ft. Fishing boats south of Iceland were finding winds above 40 kn. At 1200 the PETREL was near Fastnet Rock with 45-kn gales and 23-ft seas.

As the storm moved over the Norwegian Sea, it weakened rapidly and finally disappeared over Finland on the 12th.

Monster of the Month--A weak LOW had formed near Quebec on the first chart of the 9th. As it moved over open water, it intensified rapidly. The fishing trawler CAPT. COSMO was last heard from late on the 8th; it had reported 15- to 20-ft seas while fishing off Georges Bank. The boat was due in port on the 9th. The Coast Guard found no trace of the boat or crew. Other fishing boats reported the winds and seas increased overnight and the next day. By 0000 on the 10th the LOW was 992 mb. At 1200 the pressure was 960 mb. The ASIA HAWK (46°N, 51°W) had northerly 53-kn winds

and a pressure of 987 mb. The EUROLINER (43°N, 50°W) had southwesterly 58-kn winds and a pressure reading of 960 mb. The swell waves were 30 ft.

The tightly wound storm continued a northeasterly track. At 0000 on the 11th the ZEALANDIC (46°N, 43°W) encountered 55-kn southwesterly winds. Six hours later the winds were 60 kn and the swells 33 ft. At 1200 the PAGET near 53°N, 50°W, reported 47-kn northerly winds with 13-ft seas and swells of 20 ft. At 1800 the QUEEN ELIZABETH II was in the southeast quadrant of the storm and was battered by 60-kn winds out of the southwest and 39-ft swells. Her pressure dropped to about 991 mb. The ship's log indicated she started encountering the heavy swells on the 10th. The wind increased to force 12 during the morning of the 11th with very heavy southwesterly seas and swells. Near noon ship time, a rough sea hit the starboard bow and damaged the rail and port platform. Early on the 12th the seas gradually subsided and the ship was able to slowly increase speed. About 20 out of 1,213 passengers were injured, and damage was estimated at $50,000 including bent bow rails and torn hull plates. The first article in this issue, on page 71, is an evaluation of this storm and its high waves by Richard James of the Naval Oceanographic Office.

The high winds and seas continued through the 12th although the storm was weakening. Charlie measured 45-kn winds and 26-ft seas. A vessel near 54°N, 36°W, had 60-kn winds. The IXIA (56°N, 29°W) also had 60 kn and 39-ft seas and swell waves. Charlie reported 30-ft swells at 1800.

On the 13th the 980-mb storm swept the southern coast of Iceland. Ocean Weather Station Lima reported winds of 46 kn and seas of 20 ft. As the storm crossed the Norwegian Sea, ships there and on the North Sea reported winds in the 40-kn category and waves up to 25 ft. As the LOW approached the coast of Norway on the 15th, it suddenly turned northward and ended over the Barents Sea.

On the 14th a storm was approaching the southwest coast of Greenland across the Davis Strait, and another storm moved toward Iceland. Both storms dissipated into other circulations, and at 1200 on the 15th another LOW was analyzed off the southeast coast of Greenland. By 1200 on the 16th the 980-mb storm was at 62°N, 10°W. Lima measured 40-kn winds and 16-ft waves. Many ships on the North and Norwegian Seas reported during this period. Several had winds near 50 kn, but the GTOT had the highest waves. She reported 39-ft seas and swells of

41 ft near 57°N, 11°W. A station on the Outer Hebrides measured 40-kn southerly winds.

The storm moved ashore over central Norway on the 17th. The many ships and platforms in the North and Norwegian Seas were all reporting winds over gale strength, with many over 50 kn. A ship with the call letters RIGG reported 74-kn winds and 25-ft seas near 61°N, 01.3°E, at 0600. The highest seas appeared to be 33 ft in the same general area. At 1800 the POSEIDON (63°N, 05°E) had roaring 60-kn winds and 30-ft seas. As the storm continued inland, the reports rapidly dropped off, and by the 18th the storm was no longer of concern to the mariner.

Gillette, Wyo., was the birthplace of this storm late on the 18th. It crossed the Labrador coast on the 21st. At 1200 on the 22d the storm was 980 mb and south of Kap Farvel. A SHIP was within sight with 52-kn northeasterly winds, 26-ft seas, and a pressure of 989 mb. The circulation extended eastward to the fishing grounds south of Iceland, where five Icelandic fishing boats reported winds in the 40-kn range. On the 23d the highest wind was 52 kn reported by the GODAFOSS (55°N, 50°W) south of Greenland, and the highest waves were 25 ft reported by the C.P. VOYAGEUR (52°N, 45°W). The RIGOLETTO encountered 58-kn winds and 30-ft swells on the 24th near 58°N, 18°W.

As the storm moved across Iceland on the 25th, it stalled off its east coast for about 24 hr before moving into Norway and finally dissipating.

This LOW formed over the Gulf of St. Lawrence on the 25th. It almost dissipated on the 26th, but a short-wave trough in the upper air changed to a closed LOW, and the surface LOW rapidly intensified on the 27th. At 1200 on the 28th the central pressure was 984 mb near 61°N, 15°W. The C.P. DISCOVERER (57°N, 20°W) was sailing into 50-kn westerlies and 23-ft waves. Lima measured 20-ft seas. The report from "OWS LIMA" for 0000 on the 29th indicated 40-kn winds, 18-ft seas, and 54-ft swells.

As the storm moved into the North Sea, the many ships and platforms reported gales of around 40 kn. Most of the seas were 10 to 20 ft. Lima's wave report had dropped to 20 ft. The storm crossed inland west of Denmark on October 1 letting the North Sea relax.

Lake Huron spawned this storm on the 27th. It deepened rapidly on the 29th as it moved over the Gulf of St. Lawrence and produced a few gale reports. On the 30th the CAST BEAVER (53°N, 44°W) was hit by 45-kn southwesterly winds with 23-ft waves. A station on the southern coast of Newfoundland measured 40-kn winds. The SMELYY off Hopedale had bone-chilling 50-kn northerly winds at 5°C. Her 0600 report indicated 74 kn with a pressure of 981 mb. Late this day the storm's center crossed Kap Farvel at 970 mb.

On October 1 several ships reported 50-kn winds with many in the 40's. Among them was the GRONLAND (59°N, 39°W) with 52 kn and 33-ft seas. At 0600 on the 2d the FRITHJOF (65°N, 35°W) had 50-kn northerly winds and 36-ft waves, and at 1800 the ANNE JOHANNE (61°N, 25°W) braved 60-kn westerly winds. Other ships were reporting waves up to 25 ft. The BAMSA DAN had hail showers near 61°N, 18°W. On the 3d the FRITHJOF had 60-kn winds from the west with the seas still running at 36 ft. Lima was measuring winds over 40 kn, and the seas were in the vicinity of 25 ft. On the 4th the storm was over the Norwegian Sea at 984 mb. Fishing boats, ships, and rigs south into the North Sea had gales. The storm crossed into central Norway on the 5th, and a coastal station had 50-kn winds more due to funneling in a fjord than the pressure gradient.

Casualties--The 7,063-ton Japanese cargo vessel ANGEL sank after she was cut in two in a collision with the 8,634-ton Greek cargo vessel DIGNITY in thick fog about 24 mi northwest of Leixoes, Portugal, on the 20th. Thirteen crewmembers from the ANGEL were rescued and 11 were missing. The DIGNITY sustained severe bow damage and was towed by the tug MONTE XISTO to Leixoes.

The Greek-registered ADMIRAL C. (7,411 tons) struck a rock in heavy weather, breaking her back, on the 13th near 36.9°N, 21.7°E. The crew was rescued.

SMOOTH LOG, OCTOBER 1978--This month there are three primary climatological storm tracks according to the U.S. Navy Marine Climatic Atlas of the World - North Atlantic Ocean. The northernmost one comes out of Canada and turns northward over Labrador into Baffin Bay. The center one originates over the U.S. East Coast, crosses Newfoundland, and moves on to Iceland and the Greenland Sea. The southern track begins off the U.S. Coast near 40°N, 55°W, and proceeds northeastward to the Faeroe Islands and Norway. The actual mean tracks this month followed the gross climatic pattern. The northern track into the Baffin Bay was farther north than normal--Hudson Bay to Resolution Island and into Baffin Bay. The central track came across southern Canada to the Strait of Belle Isle to the Denmark Strait and into northern Norway. The southern track originated off Cape Hatteras and moved eastward prior to turning northeastward and stopping south of Iceland.

Storms usually do not cross the Greenland Icecap and survive, but this month five storms made it. One storm that originated near St. John's crossed the normal traffic flow on a southeasterly course, made a large clockwise loop, and ended less than 500 mi from its starting point.

This month the mean pressure pattern had radical differences from the climatic version. There were three low-pressure centers between 60° and 70°N from Baffin Bay to the eastern Barents Sea. The deepest Low was 996 mb near the southern tip of Novaya Zemlya. A 1002-mb Low was near the climatic position of the Icelandic Low between Greenland and Iceland. The third Low was also 1002 mb over southern Baffin Bay. The first and third Lows were anomalous according to climatology.

The major high-pressure center was located over the Brest Peninsula of France at 1024 mb. This center was an extension of a long, narrow ridge that stretched westward along 45°N from a 1029-mb center over Siberia. A 1019-mb high-pressure center that corresponded to the climatic center was near 30°N, 50°W, or 20° longitude west of its normal position.

This shifting of the pressure centers resulted in four significant anomaly centers. The largest was a minus 11 mb over the southern Barents Sea. Next was a positive 10-mb center off the Irish coast. A

minus 7-mb center was over the Greenland Icecap, and another minus 3-mb center was near 33°N, 31°W, or near where the Azores High would normally be centered.

The mean upper air flow at 700 mb was much closer to the normal climatic pattern. A Low was centered near Ellesmere Island with another near Novaya Zemlya. This last center was shifted from its normal position near Severnaya Zemlya. There was a trough over the eastern United States with an anomalous short-wave trough slightly west of the Azores Island and another over the central Mediterranean Sea. These latter two troughs produced an anomalous ridge over the Bay of Biscay.

The month produced three tropical cyclones--tropical storms Irma and Juliet and hurricane Kendra. The annual article describing the tropical cyclones of 1978 begins on page 76 of this issue.

Extratropical Cyclones--The first storm of the month formed southeast of Wilmington, N.C., on the first day of the month. By late on the 3d the storm was gaining strength rapidly. The MARINE ATLANTICA was in Cabot Strait with 45-kn northwesterly winds. Other ships were getting up to 40-kn gales. At 0000 on the 4th, the BEN OCEAN LANCER was north of Trinity Bay with a 60-kn northeaster and 23-ft seas. By 1200 the 984-mb storm was near 52°N, 39°W (fig. 42). The HOQT reported the highest wind of 60 kn west of the center. The WORLD SPLENDOR had 50-kn winds and 33-ft waves, while the SUGAR REFINER sustained 55-kn winds and 23-ft waves, all in the northwest quadrant. On the 5th the CRYOS was in the southwest quadrant (44°N, 45°W) with 45-kn northwesterlies and 20-ft seas.

There was a string of five LOWs in an arc from northern Norway to near 55°N, 35°W, and southward to tropical storm Irma--the fifth LOW. A 1034-mb HIGH was sitting over the Bay of Biscay. This was one of the five LOWs, but later on the 5th it disappeared, and another took its place. The AMERICAN LEGACY passed through the LOW that developed and registered a pressure of 984 mb. Her winds at 1200 on the 6th were 45 kn and were 40 kn for the next 12 hr. The seas did not build very high, but the swells were 23 ft.

This was the LOW that took the place of the one above. It had been analyzed on the 0000 chart of the 5th south of the first storm. Tropical storm Irma was over the Azores and moving northward. Ships in the vicinity were reporting gales. By the 0000 chart of the 6th, Irma had blended into the overall cyclonic circulation of the extratropical LOW. Ocean Weather Stations Charlie and Lima measured 35- to 40-kn winds and seas to 20 ft. The EHIME MARU was in the far southwest quadrant (37°N, 43°W) and reported 41-ft swells. By 1200 the 990-mb storm was near 51°N, 24°W. The AMERICAN LEGACY, OSCO SIERRA, and the PETRODVORETS had 45- to 50-kn winds with seas and swells up to 23 ft. The OSCO SIERRA coded the seas as 30 (49 ft). At 1800 the FRANKFURT was within 5 mb of the center (52°N, 25°W) with 64-kn winds and swells of 39 ft. OWS Romeo reported 25-ft seas. On the 7th the winds seemed to decrease, but many ships were battling 20- to 25-ft seas and swells. One ship just west of the center found 55-kn winds.

By 1200 on the 8th the central pressure of the storm was still only 992 mb, but there was a tight gradient between it and a 1034-mb HIGH over the central ocean. Both systems were very elongated in the north-south direction. The FRANKFURT (54°N, 14°W) was pounded by 52-kn winds and 30-ft waves. The ANCO SOVEREIGN at 46°N, 25°W, was slammed by 33-ft waves. Other ships were battered by waves in the 30-ft category, mostly in the area of long fetch on the western side.

On the 9th the storm moved north of Scotland and weakened, but a second LOW had formed off Portugal, which helped retain the tight gradient and long fetch on the east side of the HIGH. Four ships still had winds over 50 kn. The HOQT (for which no name could be found) was faithfully reporting each 6 hr. She had 34-ft seas and swells. The RIGG at 53°N, 13°W (in the same boat as far as a name was concerned) was battered by 39-ft swells and 33-ft seas. The storm dissipated on the 10th.

This LOW came out of the Dakotas and swung across the Great Lakes. As it moved across Quebec, its southerly circulation came up against that stubborn HIGH over the central ocean, which was mentioned above. The gradient close to the center itself was lax, but it was very strong east of the front. On the 8th the storm was near Frobisher Bay at 992 mb. The BAKKAFOS was on the Labrador Sea off Hamilton Inlet with 58-kn south-southeasterly winds. On the 9th the OXSQ near Sondre Stromfjord fought 52-kn southerly winds. Later in the day the PAMIUT near Frederickshab had 60-kn southeasterly winds that paralleled the rugged coast. Late that day the storm died over Melville Bay.

Several waterspouts were spotted the morning of the 10th near New Brunswick, Ga.

This LOW popped up over Newfoundland in the trough of one of the storms that crossed the Icecap. It was also the one that cut across the main northeasterly track. The HIGH had suddenly broken down on the 10th, and this LOW was picked up on the 11th. By 1800 on the 11th, the ANCO SOVERNEIGN had made it to 42°N, 49°W, and now had 52-kn northwesterly winds and 36-ft swells with this storm. At 1200 on the 12th, the LOW was 994 mb near 44°N, 35°W. Six ships in the general area of 39°N, 43°W, reported 40- to 54-kn winds. Two of them, the C.V. STAGHOUND and POSSEHL, had 30-ft seas or swells. On the 13th the ANCO ENDEAVOUR and LINGUIST had winds of around 50 kn and waves to 34 ft. These continued all through the day. On the 14th the HOLLANDIA (41°N, 38°W) had 55-kn northeasterlies in the northwest quadrant. The waves were 20 ft. The ORBITA about 400 mi west of the center had 33-ft swells. On the 15th the 33-ft swells were transferred to the ALMUT BORNHOFEN near 38°N, 45°W. The stronger winds and the higher waves were now north of the storm as high pressure to the northwest moved eastward. On the 16th the storm started turning northward after having moved southward then westward. The storm was weakening rapidly, and it disappeared on the 18th.

This storm formed in the lee of the Rocky Mountains of Canada. It traveled southeastward and crossed Cape Hatteras around noon on the 16th. Off Cape Hat-

teras it started to spin up and at 0000 on the 18th was 1000 mb near 37°N, 62°W. Prior to this on the 17th, the CHEVRON MADRID (37°N, 68°W) found 56-kn northerly winds and 20-ft seas. The Coast Guard cutter VIGOROUS was near Nantucket Island with 62 kn from the north. On the 18th three ships near 38°N, 65°W, had winds from 44 to 52 kn and waves to 20 ft. At 1800 the LINDO at 38°N, 60°W, had 60-kn northerly winds and 23-ft waves striking her port beam. The DEFIANCE was sailing south of the storm at 1930 with a minimum pressure of 994 mb. At 1800 she had had 40-kn gales with squalls, and at 0000 on the 19th she had 41 kn with 16-ft waves. The 984-mb storm was near 45°N, 48°W, at 1200 on the 19th. The BARWA east of the center had gentle 45-kn gales, but she was battered by 25-ft seas and 33-ft swells. Winds in the 40-kn and waves in the 20-ft categories continued.

By the 21st the storm was 968 mb on the southeast coast of Greenland. The DORDRECHT was about 150 mi south of the center east of Kap Farvel with 60-kn winds and 30-ft seas on her stern. On the 22d this LOW was absorbed by another coming in from the west. High winds and seas continued through the day, but gradually decreased.

A LOW that moved eastward from the U.S. East Coast dissipated, and this LOW formed in the broad trough near 40°N, 45°W, on the 24th. The ECKERT OLDENDORFF was near the new center and found 23-ft swells from the old circulation. By 1200 on the 26th, the LOW was still small in area, but the pressure was now 988 mb. The AMERICAN ARGOSY had sailed almost directly into its center with 990-mb pressure, 40-kn westerly winds, and 15-ft waves. On the 27th a Soviet ship was southwest of the center and found 45-kn northwesterly winds with 36-ft waves. Other ships were reporting 20- to 25-ft swell waves. The storm was on a northeasterly track; it was absorbed by a stronger system on the 29th.

A frontal wave was the start of this vicious storm. In less than 24 hr it had consolidated into an intense circulation. A French ship was off St. John's with 44-kn southerly winds on the 28th. At 1200 the ATLANTIC SAGA was 350 mi southeast of the 972-mb center with 45-kn winds and 33-ft seas; by 1800 the seas had dropped to 26 ft. The MANCHESTER CONCORDE at 53°N, 49°W, was fighting 52-kn winds and 23-ft waves. On the 29th her sister ship, the MANCHESTER COURAGE, was sailing eastward in the opposite direction with 43-kn winds and 23-ft seas. OWS Charlie was on station with 16-ft seas and 23-ft swells.

Winds of 40 to 50 kn and waves to 25 ft continued into the 30th. At 1200 the MERCANDIAN CLIPPER (60°N, 29°W) had 60-kn westerly winds. Icelandic fishing boats were buffeted by persistent winds over 40 kn. On the 31st the LOW became stationary near 65°N, 35°W, until November 3, when it finally dissipated.

This frontal wave formed in the southern part of the col area between two HIGHs on the 30th near 39°N, 52°W. It was a well-formed storm 24 hr later, and strong gale-force winds were already blowing by 1200 on the 31st. The BOOKER VANGUARD was 450 mi to the east with 23-ft swell waves. The wind barb could not be read because of the analysis. The ZEALANDIC (48°N, 33°W) was ravaged by 60-kn northerly winds with a pressure of 994 mb. She was less than 100 mi from the 990-mb center at 1800. The USNS METEOR was passed by the storm near 49°N, 31°W, where she recorded a minimum pressure of 987 mb. Early on November 1 six ships along 50°N on both sides of the storm radioed winds between 40 and 50 kn. The highest waves were 25 ft reported by the GENE TREFETHEN at 51°N, 29°W. By 1200 the LOW had disappeared.

Casualties--The 30,408-ton Greek tanker CHRISTOS BITAS ran hard aground 4.5 mi east of Smalls Lighthouse (51.7°N, 05.7°W) on the 12th. The vessel developed a heavy list and was in danger of sinking. Pumps were placed aboard to lighten the cargo, but lightering was delayed by bad weather, winds up to 35 kn, and seas to 15 ft. Over 35,000 tons of oil were transferred to the tanker BRITISH DRAGOON by the 22d. The owners decided to scuttle the ship, and on the 31st she was sunk in 2,600 fathoms, approximately 300 mi west of Fastnet Rock.

The 424-ton German VAGABUND and the 4,185-ton Polish ZAMBROW collided in fog in the Kiel Canal on the 14th. The American dredger GEORGE A. MCWILLIAMS sank in heavy seas in Breton Sound in the Mississippi River Gulf on the 15th. All of the crew were rescued with none injured.

The 4,892-ton Norwegian GOLAR BORG sustained a serious list in heavy weather on the 31st while about 675 mi west of the Azores. Twenty-two of the 26 crewmembers were picked up by the HARDANGER. The vessel was reported on her side with starboard side up in heavy seas. Later, she could not be found. The CANMAR SUPPLIER IV (1,190 tons) encountered ice at Tuktoyaktuk, Northwest Territories, on the 30th, which caused the flooding of a double-bottom tank.

# Smooth Log, North Pacific Weather

## September and October 1978

SMOOTH LOG, SEPTEMBER 1978--There were two primary storm tracks this month. One more or less paralleled its climatological counterpart from Honshu to the Gulf of Alaska. The other corresponded to a secondary climatological track across Sakhalin Island into the Bering Sea. The last week of the month there were several storms that formed south of the Gulf of Alaska and moved northward into the Gulf.

The gross pressure pattern did not differ radically from climatology, but there were quite a few in detail. The largest feature was the Pacific High at 1023 mb. The central pressure was 2 mb higher and at 33°N,

158°W, about 600 mi west of its normal position. The eastern half had the same configuration as climatology with a slight ridging along the coast and mountains. The western half was much broader in a north-south direction than its climatological counterpart. The Aleutian Low had two 1005-mb centers--one near Kodiak and the other near Bethel, Alaska. The climatic center was 1006 mb over Bristol Bay.

The two principal anomaly centers were both 5 mb. The negative one was centered over the Gulf of Alaska near 54°N, 135°W, reflecting the LOW near Kodiak Island. The positive center was near 47°N, 170°W, and reflected the abnormal width of the western part of the Pacific High.

There were significant differences in the upper air flow pattern at 700 mb. The usual long-wave trough along 170°W was replaced by a closed LOW over St. Lawrence Island. There were two trough lines out of this LOW. One stretched southeastward across Bristol Bay and paralleled the North American west coast. The other extended southwestward across the Near Islands to the vicinity of 35°N, 145°E. The long-wave trough inland of the Asian coast resembled a short-wave trough.

There were seven tropical cyclones over the northern Pacific. In the east there was tropical storm Paul and hurricane Olivia. In the west there were typhoons Irma, Judy, Lola, and Mamie and tropical storm Kit.

Extratropical Cyclones--A frontal system that moved off the Asian continent occluded rapidly as it passed over the Kuroshio Current. The VAN ENTERPRISE (38°N, 149°E) was slightly east of the front with 45-kn southerly winds and 20-ft waves. At 1200 on the 4th a wave was analyzed near 45°N, 152°E. A U.S.S.R. ship was within a few miles of the center with 41-kn southerly winds, 16-ft waves, and a pressure of 998 mb. This report and those of two ships west of the center indicated the wave's formation. On the 5th the PRESIDENT EISENHOWER was east of the front with 35-kn gales. At 2100 the GARDEN STAR and at 0000 on the 6th a SHIP, both near 49°N, 170°E, reported 40-kn winds and 23-ft seas. This position was 200 to 300 mi southwest of the 987-mb center. On the 7th the storm split into two centers with the eastern one dominating as it moved over Alaska.

This LOW was discovered over the Sea of Japan on the 9th. It deepened rapidly late on the 10th as the circulation moved over the open ocean. On the 11th the ship 5MCN was north of the center with 38-kn easterly winds. On the 12th the TAKARA (48°N, 172°E) was sailing into 45-kn northeasterly winds and 12-ft seas.

The LOW was headed northward into the Gulf of Alaska on the 14th. The ARCO ANCHORAGE had 43-kn winds near 52°N, 137°W, at 0000. The seas were 21 ft. This was probably the same ship that had the 1800 report of 49 kn. The CHEVRON COLORADO had 52 kn from the south-southeast. The MOBIL MERIDIAN was near 58°N, 145°W, at 0600 with 54-kn measured winds, 12-ft seas, and 38-ft swells. At 1800 the OVERSEAS WASHINGTON (53°N, 138°W) was sailing southeastward with 46-kn southwesterly winds and 33-ft swells pounding her starboard side. On the 15th the storm's center passed almost directly over Valdez. At midday the ALEUTIAN DEVELOPER was at 53°N, 140°W, with rainshowers, 37-kn winds, 16-ft seas, and 33-ft swells. The MOBIL MERIDIAN was only 2.5° longitude east with 31-ft swells. The storm broke up on the southern mountains on the 16th.

This frontal wave formed near 45°N, 154°W, on the 11th. Twenty-four hours later it was a 980-mb storm near 52°N, 151°W. The ARCO PRUDHOE BAY (54°N, 138°W) had 45-kn gales. The ARCO ANCHORAGE was off the southern coast of Alaska (58°N, 144°W) north of the storm with 70-kn northeasterly winds. At 1200 she reported 65-kn southeasterlies and 20-ft seas. By the 13th the winds had dropped to 35 kn. At 0600 the ARCO FAIRBANKS had 50-kn southeasterlies near Middleton Island. On the night of the 12th and 13th the barge MIAMI in tow of the tug BERING QUEEN broke loose in winds estimated at 50 to 70 kn and 25-ft seas. The barge was found aground on the 13th west of Point Hinchinbrook. At 1800 on the 13th a SHIP near 53°N, 138°W, had 49-kn winds and 18-ft waves. On the 13th the storm moved across the Alaska Peninsula and dissipated.

This storm formed off Hokkaido late on the 16th in the broad circulation associated with typhoon Judy. On the 17th Judy became extratropical as the two low centers combined. Many ships reported gales in the vicinity of 45°N, 148°E. This was over the fishing grounds off Ostrov Iturup.

At 0000 on the 18th, the 982-mb storm was near 44°N, 153°E. The PRESIDENT MADISON measured 50-kn northeasterly winds with 30-ft waves near 47°N, 153°E. A SHIP near 47°N, 166°E, was tossed by 43-kn winds, 16-ft seas, and 33-ft swells. One of the Kurile Islands measured 45-kn winds. At 1200 and 1800 a SHIP that moved from near 48°N, 170°E, to 48°N, 172°E, had 45- and 38-kn easterly winds, 33-ft seas, and 57- and 54-ft swells. All parts of both observations looked good. The pressure center was filling, and on the 19th the storm was traveling southeastward.

On the 21st the LOW reached its farthest southern position and again turned north. The central pressure was holding slightly below 1000 mb with the winds below gale force. Heavy rains were recorded in the northeast quadrant. On the 23d the LOW was squeezed out of existence between two high-pressure centers.

This storm formed only a few hours after the previous one, but it formed over the eastern ocean near 50°N, 160°W. As it moved northward it absorbed another LOW traveling eastward along the Aleutians. On the 19th OWS Papa measured 39-kn winds.

At 0000 on the 20th the large storm--2,000 mi to the east and west by 1,800 mi north and south--was 990 mb over the southern coast of Alaska. The VAN ENTERPRISE was headed toward Cape Flattery with 58-kn winds out of the southeast. At 1800 the YING YUNG was south of Unimak Island. The winds were 40 kn from the west, the seas were 25 ft, and the swells 33 ft. The storm was making a counterclockwise loop off the coast, and from the 21st to the 23d it was stationary twice off Dixon Entrance. From the 24th to the 25th a circulation was barely identifiable.

This was one of the storms that formed north of Hawaii and off the California coast. The Pacific High had broken down several days earlier with a center

over midocean. The first chart on the 25th indicated a large, weak cyclonic flow near 38°N, 141°W. The center moved northward and within 24 hr was 986 mb. At 0600 on the 26th the HAKUSAN MARU was west of the center in the tighter gaadient (46°N, 145°W) with 45-kn winds from 330° and 16-ft waves. At 1800 the OVERSEAS JUNEAU (51°N, 134°W) had 40-kn easterly winds. A SHIP southwest of the center complained of 45-kn westerly winds. Six hours later she had sailed very near the storm's center, recording a 992-mb pressure with 50-kn winds out of the south and 20-ft seas near 50°N, 133°W. At 0600 the EXXON NEW ORLEANS (51°N, 134°W) had southerly 55-kn winds, 991-mb pressure, 33-ft seas, and 38-ft swells.

On the 28th the storm was in the dissipating process and finally disappeared on the 30th as it moved ashore.

A continuous front stretched nearly across the North Pacific. A frontal wave developed on the front off Honshu on the 30th. By October 2 the 992-mb storm was developing minimal gales. The PRESIDENT MCKINLEY (43°N, 179°W) had 20-ft swell waves on her port beam. At 1800 a SHIP near 39°N, 166°W, found 51-kn winds. On the 3d the USNS S.P. LEE at 35°N, 166°W, was about 500 mi south of the 988-mb center and also had 50-kn winds. She was hammered with 34-ft seas and 41-ft swells. Another ship near 39°N, 166°W, reported 23-ft seas and 33-ft swells.

The BLUE OCEAN was east of the 984-mb center on the 4th with 45-kn winds and 26-ft seas and swells. Later in the day the SEALAND MCLEAN was sailing eastward near 51°N, 148°W, with 40-kn winds, 16-ft seas, and 25-ft swells. On the 5th, another LOW moved into the Gulf of Alaska and absorbed this storm.

Tropical Cyclones, Eastern Pacific--The quiet of September was shattered by hurricane Olivia on the 20th. Born from the remnants of North Atlantic hurricane Greta, Olivia was picked up over southern Mexico. She made it out into the Gulf of Tehauntepec and reached hurricane strength on the 21st. The following day, packing 65-kn winds, Olivia turned northward, moved back onshore late on the 22d just east of Salina Cruz, and weakened rapidly. Meanwhile, Paul was developing 360 mi to the west-southwest. He paralleled the coast and reached tropical storm strength on the 25th as he crossed the 20th parallel near 109°W. Winds reached 40 kn near Paul's center as he brushed the tip of Baja California. Paul turned northeastward across the Gulf of California and made landfall just south of Los Mochis on the 26th. Later in the day Paul had dissipated into a large area of thunderstorms over north-central Mexico.

Tropical Cyclones, Western Pacific--September's first born was typhoon Irma, nutured in the East China Sea. Christened on the 12th just east of Taipei, the developing youngster headed northward. The ZIM HONG KONG was northeast of the storm with 55-kn winds and 26-ft waves. On the 14th after crossing the 30th parallel, Irma matured into a full-blown typhoon. The ILLINOIS (31°N, 125°E) experienced 45-kn winds and 12-ft waves. At this same time, typhoon Judy had sprung to life 300 mi east of Iwo Jima. She was on a north-northwestward course and reached typhoon intensity on the 14th just before crossing the 30th parallel. Both storms recurved toward the northeast. Irma's winds climbed to 90 kn before crashing ashore over Kyushu on the 15th. At Fukuoka the winds were clocked at 89 kn--the highest since the observatory was established in 1939. Torrertial rains and high winds caused 5 deaths and thousands of flooded houses. Most of the damage was confined to Fukuoka Prefecture. The recurving of Judy, however, was beneficial to Japan as it kept her and her 90-kn winds out to sea. By the 17th Judy had crossed the 40th parallel near 155°E and was turning extratropical and weakening.

Things were quiet for less than a week, when tropical storm Kit and typhoon Lola moved into the Philippines. Both formed in the Philippine Sea east of the central islands. Kit crossed central Luzon as a tropical depression on the 22d heading west-northwestward. Once into the South China Sea she began to intensify. Meanwhile, Lola was coming to life some 240 mi north of Palau Island. With a little more sea room she was able to reach tropical storm strength before brushing Samar on the 26th. Lola retained her identity as she banged through the central region on a west-northwesterly trek. Kit had passed southwestward on the 23d, gaining tropical storm strength, and on the following day she turned toward the northwest. The storm forced the 7,000-ton American containership AMERICAN SIOUX onto a reef in the South China Sea on the 24th. She was pounded by waves as high as 30 ft. The Greek freighter CAPTAIN LYGNOS rescued 19 of the 23 crewmen in a feat of superb seamanship. On the 25th, sporting 50-kn winds, Kit moved westward across Hainan for Vietnam. The following day she made landfall near Ben Thuy and turned southward. The rain-soaked area could ill afford a tropical storm. Nine provinces in the south were struggling with flooding, which had devastated the Mekong Delta rice belt last month. Meanwhile, Lola passed over Manila on the 27th. The 6,772-ton Greek-registered ARCADYRA struck a jetty at Atimonan, Luzon. All mooring lines broke, and the vessel drifted and sank near 14.1°N, 121.9°E. The vessel was refloated later and towed to Manila. Lola's journey over land left her weak, but the invigorating waters of the South China Sea quickly restored her. By the next day Lola was a typhoon heading toward the northwest. Winds near her center reached 75 kn. On the 1st Lola crossed northern Hainan. The following day as a weakening tropical storm, she moved onto the mainland near the Vietnam-China border.

Just before the month ran out Mamie showed up midway between Saipan and the Marcus Island. She headed northward and intensified. By the 2d as she reached 25°N, she began to recurve toward the northeast. She reached typhoon strength on the 3d just after crossing the 30th parallel. Peak winds reached 70 kn. Mamie was already pretty far north, so cool air began to intrude into her circulation. By the 4th she was once again a tropical storm as she accelerated rapidly northeastward.

Casualties--The 9,085-ton British-registered SEA MOON requested a survey for heavy weather damage while at Kobe on the 4th. The night of September 9 and 10 a cold front moved onto the Oregon coast and sank many fishing boats. The 14,800-ton Brazilian LLOYD GENOVA ran aground in heavy weather near Salina Cruz, Mexico, on the 22d.

SMOOTH LOG, OCTOBER 1978--The preferred mean storm path that primarily affected marine activity originated near Japan with an east-northeasterly path until the area of 45°N, 160°W, where it turned sharply northward to the south coast of Alaska. Another path came across northern Sakhalin Island and then into the Bering Sea. The Gulf of Alaska and Bristol Bay area was a mass of tracks as most storms moved into that area. Only two storm centers moved inland south of 60°N, one during the first week of the month and one the last week. Several storms wandered around the ocean north of Hawaii. These tracks compared favorably with climatology, except the northern path over the Sea of Okhotsk was farther north and more easterly oriented than normal. Also, a branch of the southern track that usually continues eastward toward the Queen Charlotte Islands was missing.

The mean pressure pattern reveals why the Queen Charlotte Island branch was absent. A 1023-mb Pacific High was centered near 41°N, 137°W, and ridged up the West Coast. This center is normally 1019 mb near 30°N, 140°W. The Aleutian Low was 997 mb over Bristol Bay, instead of 1001 mb north of Kodiak Island according to climatic records. There was an anomalous High over the East Siberian Sea.

The primary anomaly center was plus 8 mb off Vancouver Island; it was associated with the Pacific High. A minus 5-mb center was over southwestern Alaska. The largest anomaly center was plus 9 mb north of Wrangel Island and did not directly affect the weather experienced by most ships.

The upper air at 700 mb was nearly a carbon copy of climatology. The major exception was the Low over southwestern Alaska, which was deeper than usual and produced a pronounced ridging over northeastern Siberia.

In the eastern Pacific, hurricane Rosa and tropical storm Sergio completed the season. The central Pacific produced hurricane Susan, and the western Pacific was host to typhoons Nina, Ora, Phyllis, and Rita.

Extratropical Cyclones--Many thanks to the Port Meteorological Officer at Seattle, Don Olson, who sent the October radio log of Peggy Dyson (WBH-29). Many of these reports will be used in the following narratives. The first storm of the month was a continuation of typhoon Mamie. By 1200 on the 5th, it was a 984-mb LOW at 46°N, 178°E. The storm moved eastward with minimal gales until late on the 6th. At 1800 the NBMC radioed the first strong gale report of 44 kn in the southwest quadrant. There were several reports of 40 kn on the 7th. The PRESIDENT POLK (40°N, 154°W) sent one of them. Two Japanese ships had 25-ft waves. The NITTEN MARU (42°N, 154°W) reported 26-ft swell waves at 0600. At 1200 the storm was nearly centered over OWS Papa.

Early on the 8th the GLACIER BAY had 50-kn southeasterlies and 33-ft waves near 53°N, 137°W. The CHIKURA MARU (55°N, 140°W) was sailing into 26-ft swells. A ship far south along 42°N had 25-ft westerly swells. The BLACK HAWK (59°N, 147°W) and NEOGA at Kayak Island reported 50- to 60-kn winds with gusts to 80 kn. The BLACK HAWK had 30-ft southeasterly swells. The storm was now 962 mb near 54°N, 145°W. The ARCO PRUDHOE BAY near Montague Island measured 65-kn winds from the southeast with 25-ft waves. As the storm crossed Cook Inlet, it filled rapidly.

This storm matured from one of a series of frontal waves east of Tokyo on the 5th. The first high winds and waves came on the 7th. The NATALIE BOLTON (41°N, 155°E) found 44-kn northwesterlies. The KATENDRECHT north of the center had easterly 40-kn gales and 23-ft waves. The PRESIDENT JEFFERSON (49°N, 166°E) had 60-kn easterly winds and 17-ft waves slapping her port quarter. The 980-mb storm was near the Near Islands at 0000 on the 8th with strong winds and high seas. The TOYOTA MARU No. 10 moved only one-tenth of a degree of longitude in 3 hr near 49°N, 170°E, as she contended with 60-kn winds and 30-ft waves. The PRESIDENT JEFFERSON was farther west with only 45-kn winds, but the swells were 28 ft. The KATENDRECHT was not doing any better with 55 kn and 26 ft. The WESER EXPRESS located the strong wind and wave band at 1800 on the 9th near 50°N, 158°W. At this time the LOW was moving along the Alaska Peninsula. On the 10th two SHIPs along 50°N between 150° and 160°W were hit by 28- to 33-ft waves. The storm moved ashore late on the 10th.

A LOW formed just north of Hokkaido on the 11th and moved northward. It suddenly turned southeastward on the 12th. On the 13th it caught at least five Soviet fishing vessels near 44°N, 150°E, with winds of 40 to 50 kn. At 1200 on the 14th the 980-mb center was close to 47°N, 157°E. The OHMINESAN MARU signaled 50-kn winds and 16-ft seas, while the PROFESSOR was instructed by 47-kn winds and 26-ft seas. Early on the 15th the WESER EXPRESS was sailing toward Japan with 60-kn winds and 39-ft swells pounding her starboard side near 40°N, 160°E. Three-hundred miles to the south a ship had 23-ft waves and 28-ft swells. At 0600 the WESER EXPRESS had sailed less than 50 mi in the past 6 hr, probably due to 46-ft swells. Other ships radioed reports of 25- to 30-ft waves.

The high winds and particularly high swell waves continued into the 16th. The GOLDENROD at 41°N, 172°E, about 350 mi southwest of the LOW, struggled with 51-ft swells. The day before she had been engulfed in 49-ft swell waves while measuring 65-kn winds. Another ship near 37°N, 180°, reported 41-ft swells. Several others had 25- to 30-ft seas or swells. On the 16th the storm swung northward, and on the 17th it was absorbed by a LOW that had preceded it.

The report from one SHIP indicated the formation of this frontal wave on the 1200 chart of the 11th. The nearest land report was from the French Frigate Shoals, and the closest reports from other ships were about 800 mi away. The frontal wave was near 39°N, 161°W. It raced northeastward with winds up to gale force. At 1200 on the 13th it was 986 mb near 59°N, 150°W. The MOBIL MERIDIAN was near 58°N, 144°W, with 65-kn southwesterly winds and 26-ft seas. The JARVIS measured 50-kn winds nearby, but the seas were only 13 ft. The storm was centered near Valdez on the first chart of the 14th and no longer existed by the middle of the day.

This extratropical storm was born out of tropical storm Ora on the 15th. It brought heavy rain to Japan as it moved south of the Islands. On the 16th 20-ft

swell waves were found east of the storm along the warm front. On the 17th a SHIP reported 45-kn gales and 16-ft seas behind the cold front. The SURUGA MARU had 55-kn winds and 26-ft waves west of the center and south of a small LOW that was trailing this one and reinforcing the gradient.

On the 18th the 988-mb center was near 40°N, 170°E, at 0000. The FRIENDSHIP was north of the storm at 42°N, 167°E, with 40-kn easterly winds, 25-ft seas, and 30-ft swells. As the storm approached the dateline on Wednesday, a ship on the Tuesday side had 40-kn easterly gales and 26-ft seas. The storm crossed the dateline on the 19th, and the FRIENDSHIP and SANKO-SUN had 40- and 45-kn winds and waves to 27 ft while west and north of the storm, respectively. Later in the day the MEDITERRANEAN CARRIER, near 37°N, 166°E, fought 45-kn westerlies, 25-ft seas, and 36-ft swells.

As the storm moved northward into the Gulf of Alaska, it weakened with only minimal gales and less than 20-ft waves.

Monster of the Month -- This weak storm gradually worked its way from the eastern U.S.S.R. across the Kamchatka Peninsula into the open water on the 21st. It was meant for greater things when it was reinforced and strengthened by extyphoon Phyllis. On the 22d the 986-mb LOW was near 56°N, 178°E. There was a wave on the associated front near 44°N, 168°E, and Phyllis was near 39°N, 168°E. Several ships east of the front reported 40-kn gales with waves about 15 ft. A 1031-mb HIGH was blocking eastward movement, and the gradient was tighter on that side. The frontal wave and Phyllis joined on the 22d and raced northward up the front, greatly strengthening the LOW out of the U.S.S.R. The TAUBE (36°N, 165°E) was east of Phyllis at 0600 with 50-kn winds and 20-ft seas. The 198-ton crab processor MOKUHANA was damaged by the 3,847-ton ROYAL VENTURE in Dutch Harbor during this severe weather. The GOLDEN DAISY (50°N, 176°W) measured 58-kn southerly winds with 23-ft waves. On the 23d everything hit the fan. The eastern edge with southerly winds had reached Bristol Bay. Ships all over the area from the Bering Sea south to 35°N and 160°W to 160°E had high winds and waves. Among others the SAMUEL S. measured 64-kn winds, the NEPTUNE DIAMOND had 48-kn winds with 25-ft waves, while a German ship encountered 30-ft swells. Later in the day the MAMMOTH FIR and PHILADELPHIA had 40- to 45-kn winds and seas to 33 ft.

Among the Aleutians the fleet really caught it. WBH-29 had 28 radio reports on the 23d. Many ships reported southeasterly winds of 60 to 80 kn with five of them reporting gusts to 100 kn. The lowest barometer reading by the YUKON off Dutch Harbor was 965 mb (28.50). The TARPIN near 54.7°N, 163.2°W, reported 30- to 40-ft swells. The KEY WEST near 56.1°N, 163.1°W, reported 50- to 60-kn southeasterlies gusting to 70 kn with 25-ft southerly swells. The vessel declared a Mayday and sank. At 0000 on the 24th, the large 958-mb storm was near 59°N, 166°W. At this time it turned southward, then eastward, moved over the Gulf of Alaska, and later down the Alaska panhandle. The GLADIOLUS (45°N, 175°E) had 60-kn west-northwesterly winds and 20-ft waves. The NORTH STAR III (54°N, 164°W) had 45 kn and 23-ft seas. The winds and waves had quieted some, but the EXPRESS and PACIFIC MARINER in the vicinity of Amak Island reported southwesterly 60-kn winds and gusts to 95 kn. The waves were still generally 25 to 30 ft, but the BULL DOG off Akutan called the swells 35 to 40 ft from the southwest. The ALEUTIAN PROVIDER (56.7°N , 147°W) said the swells were 30 ft from the south-southwest. On the 25th three previously named ships around 53°N, 167°W, had waves of 30 ft or more. After the LOW crossed the Alaska Peninsula the pressure rose rapidly, and the storm caused little trouble. It slowly moved southeastward paralleling the coast and moved inland over Vancouver Island late on the 28th.

This minor LOW formed in the trough of another LOW that died over Siberia. On the 28th the 984-mb storm was near 57°N, 176°W, over the Bering Sea. The JARVIS near 52°N, 176°W, had 56-kn winds on the 995-mb isobar. The EEKLO, HONGKONG PHOENIX, and GLADIOLUS all had 45- to 52-kn winds. Later, another SHIP had 30-ft seas. At this same time a frontal wave was racing eastward from over Honshu at over 60 kn. By 1200 on the 28th this LOW was at 46°N, 170°E. A ship that appeared to be the MAMMOTH FIR was south of the cold front at 42°N, 163°E, with 38-ft seas. The PRESIDENT PIERCE at 54°N, 178°W, was sailing into 30-ft seas and swells. By 1200 on the 29th this LOW had raced to near Bethel, Alaska, and was the only circulation center at 954 mb. The ELBE EXPRESS found 60-kn southeasterly winds and 30-ft swells, while the FLORIDA MARU (55°N, 170°W) not far away 6 hr later had 55-kn winds from the west with 30-ft seas and 39-ft swells. Ships reporting to station WBH-29 Kodiak were calling winds up to 70 kn with gusts to 90 kn. The ALEUTIAN DEVELOPER reported 35-ft swells. On the 30th winds continued in the 50- to 60-kn range southwest of the center with the waves up to 38 ft. The Coast Guard was conducting a communication search for the GOLDEN VIKING.

On the last day of the month the VAN ENTERPRISE (48°N, 166°W) was on the southern edge of the cyclonic circulation with 50-kn winds and 20-ft seas. Five ships between 50° and 55°N and 135° to 160°W had waves of 25 to 30 ft. A SHIP near 52°N, 135°W, east of the front, reported 41-ft waves. On November 1 the storm turned eastward in response to a frontal wave that moved around the southern and eastern periphery. An English ship was treated to 58-kn winds with the frontal wave. An American ship at 54°N, 138°W, fought 55-kn winds and another nearby had 21-ft swells on the 2d. The EXXON SAN FRANCISCO had 26-ft swells slapping her beam. The frontal wave became the primary storm and moved across the mountains.

Tropical Cyclones, Eastern Pacific--Hurricane Rosa developed on the 2d about 300 mi south of Manzanillo. Moving northwestward, Rosa became a full-blown hurricane in just 2 days. By the 4th winds near her center were 65 kn; by the 5th they were 75 kn. However, as Rosa approached the tip of Baja California, the peninsula robbed her of her power. By the 7th she was just another helpless depression that had succumbed to the Baja.

Sergio, the second Italian tropical cyclone of the month, very nearly followed in Rosa's footsteps. He was discovered on the 18th near 16°N, 107°W. Sergio moved northwestward as a tropical storm for 2 days. His maximum winds only reached 35 kn. Upper air conditions were unfavorable, and Sergio petered out on the 20th just after crossing the 20th parallel.

About the time Sergio was off the Mexican coast, hurricane Susan was throwing a scare at the Hawaiian Islands. Susan popped up along the 10th parallel near 145°W on the 18th. She headed west-northwestward as she developed. By late on the 19th she was a hurricane, but she was still a good distance from the Islands. Winds climbed as Susan's movement persisted. By the 21st it was apparent that the big storm was a real threat. A hurricane watch was put into effect for the big island of Hawaii, and a 20-ft surf was probable even with the system some 450 mi southeast of Hilo. Winds were estimated at about 110 kn near the center. This was the most intense hurricane to threaten the Islands. Early on Sunday morning (the 22d) it was thought that Susan would pass within 20 mi of Hawaii. However, there was a dramatic change during the day, and Susan began to weaken. Her central pressure, which had fallen to 930 mb late Saturday night, had risen to 981 mb by late Sunday afternoon. Then in addition Susan began to turn toward the west-southwest and continued to weaken rapidly. The only ship encounter was the FNRZ, which ran into 50-kn northeasterlies on the 23d more than 400 mi to the northeast of the storm's center.

Tropical Cyclones, Western Pacific--Typhoons Nina and Ora developed in the Philippine Sea within 2 days of each other. Nina traveled westward across the Philippines (around 15°N), while Ora headed west-northwestward. On the 9th the MAYAGUEZ rescued 15 crewmembers from the sinking LOONG HSIANG No. 11, a 114-ton Taiwanese fishing boat, near 20.9°N, 120°E. The winds were northeast at force 7 with very rough northeasterly seas and swells on the northern edge of Nina (see "Letters to the Editor"). Nina was across the Philippines by the 10th as Ora was coming to life. The rugged terrain slowed her development, but not much. Early on the 10th ships were reporting winds in the 45- to 55-kn category in 15- to 20-ft seas. The NIKKO MARU, the GUPK, and the JTCF were all having a rough time. Then the ZCKN, sailing eastward to the north of the storm's center, was buffeted by 80- to 85-kn winds out of the northeast quadrant for about 18 hr until early on the 11th. She then ran into 70-kn winds again after a brief respite. Ora was not originally classified as a typhoon, but the ship encounters indicate she was a potent storm. While Ora was roaming the South China Sea, Nina was reaching typhoon strength among the southern Ryukyu Islands on the 12th. The PRESIDENT HARRISON (26°N, 122°E) was hit by 50-kn winds and 20-ft waves. The combination of these two systems created dangerous conditions in the Formosa Strait. Winds of 50 to 60 kn whipped into 25- to 35-ft heights. This can be attested to by the GUPK, the GYNO, and the LOIRE LLOYD on the 12th and 13th. Ora's winds climbed to 80 kn near her center on the 13th. The following day she recurved toward the northeast and weakened. On the 15th she moved back out into the Pacific, just south of Kyushu, as a weakening tropical storm.

Meanwhile, Nina was recurving herself. She passed 60 mi to the west of Hainan on the 15th. She finally fizzled out just south of Hong Kong on the 17th after dumping 15 in of rain over the port in 2 days.

While Nina and Ora were dissipating, typhoons Phyllis and Rita were coming to life far to the east. Phyllis popped up about 300 mi southwest of Wake Island on the 15th. Two days later Rita made her debut some 600 mi east of Kwajalein. Phyllis moved west-northwestward then northward, and by the 18th she was a typhoon hugging the 155th meridian. Meanwhile, Rita churned on a westerly course. As a typhoon she crossed Eniwetok on the 20th and had moved 60 mi to the south of Guam by the 23d. By this time Rita was a giant. Maximum winds near her center climbed to 145 kn with gusts to 175 kn. Winds of 100 kn reached out to 25 mi, while gales extended 150 to 185 mi from her center. Guam suffered $2 million damage, and two American servicemen lost their lives. Phyllis by this time had recurved northeastward, dropped to tropical-storm intensity, and was turning extratropical as she crossed 40°N near 170°E. Rita's maximum winds remained in the 135- to 145-kn range as she approached the Philippines on a west-northwesterly track.

On the 26th Rita brought her deadly act across Luzon. The battering winds, torrential rains, and towering seas wreaked havoc throughout the central Philippines. More than 200 people lost their lives, and another 354 were reported missing. As Rita cut across rice-rich central Luzon, she mowed down more than 50,000 homes and displaced almost 1-1/2 million people. Crop and property damage were estimated at $100 million. As seen from the air, the towns of Dingalan, Gabaldon, and Sicat were totally devastated. Rita was the worst typhoon to hit the Philippines in 8 yr.

Although the rugged terrain took its toll, Rita was still a typhoon upon emerging into the South China Sea on the 27th. She remained so until the 29th. During this period several ships encountered 45- to 52-kn winds in heavy swells and seas. The NEDLLOYD MARNE battled 30-ft swells, while the STRAAT NAGOYA was bounced around on 24-ft seas. The NEDLLOYD DEJIMA ran into 52-kn northeasterlies a good distance east of the center. Rita dropped to tropical-storm strength as she was heading southwestward. She reached the Vietnam coast near 13°N as a depression late in the day.

Casualties--Six crewmembers of the 965-ton Japanese chemical tanker KAIFUKU MARU No. 18 were rescued after the ship capsized southwest of Manila on the 12th. The rescue ship was the tuna boat RYOYU MARU No. 8. Seven crewmembers were missing. The deck barge TEKKO MARU No. 1 with 400 empty 20-ft containers in tow by the tug EAST SEA broke loose and drifted into the WESTERN OFFSHORE No. VIII off the west coast of Taiwan.

The 58,213-ton Liberian bulkcarrier CHU FUJINO suffered severe weather damage. The Norwegian vessel MARIE BAKKE struck a railroad bridge over the Willamette River in fog on the 28th on her maiden voyage. Both bridge and ship were damaged.

## Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

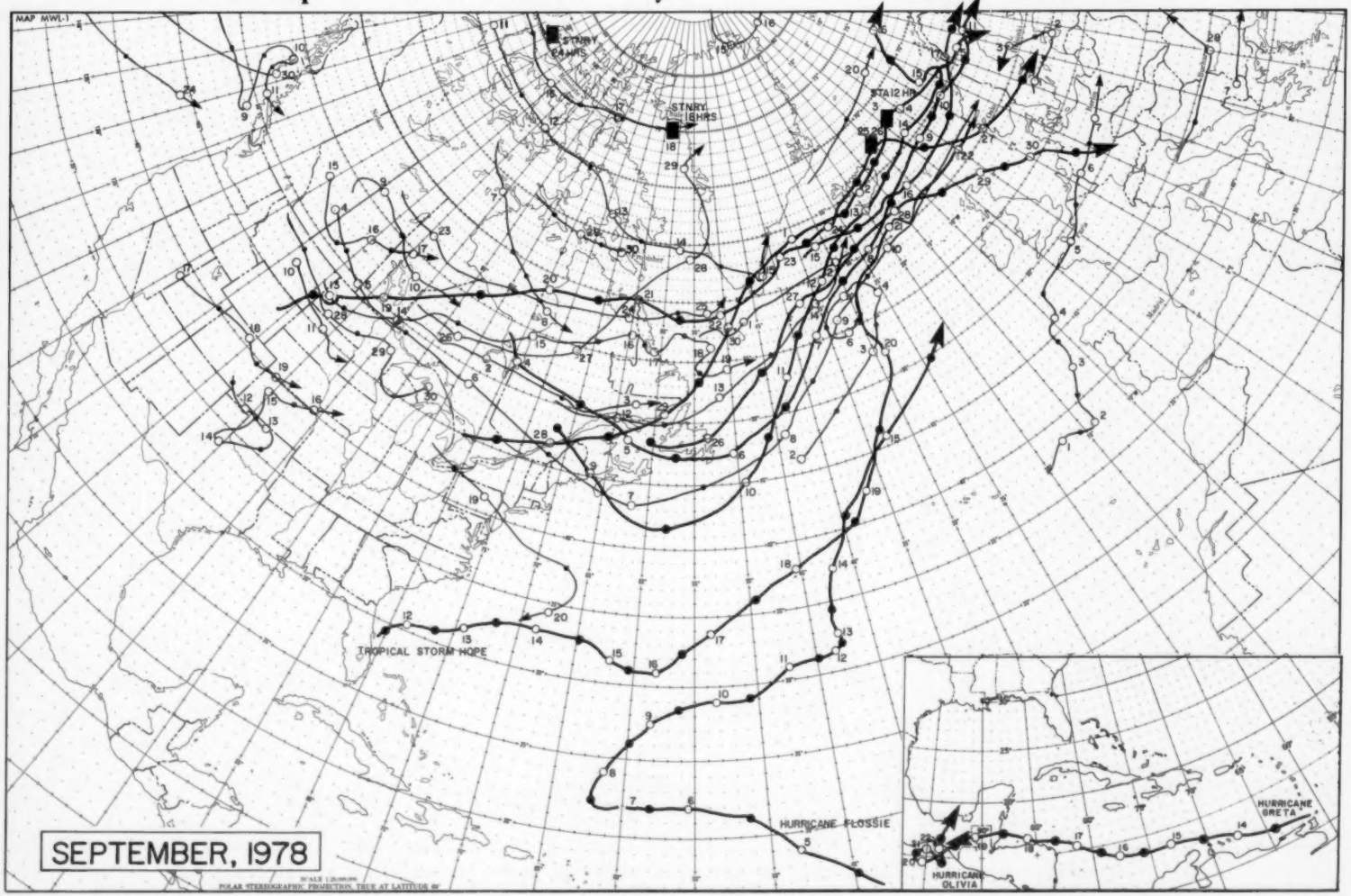



Figure 43.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

## Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

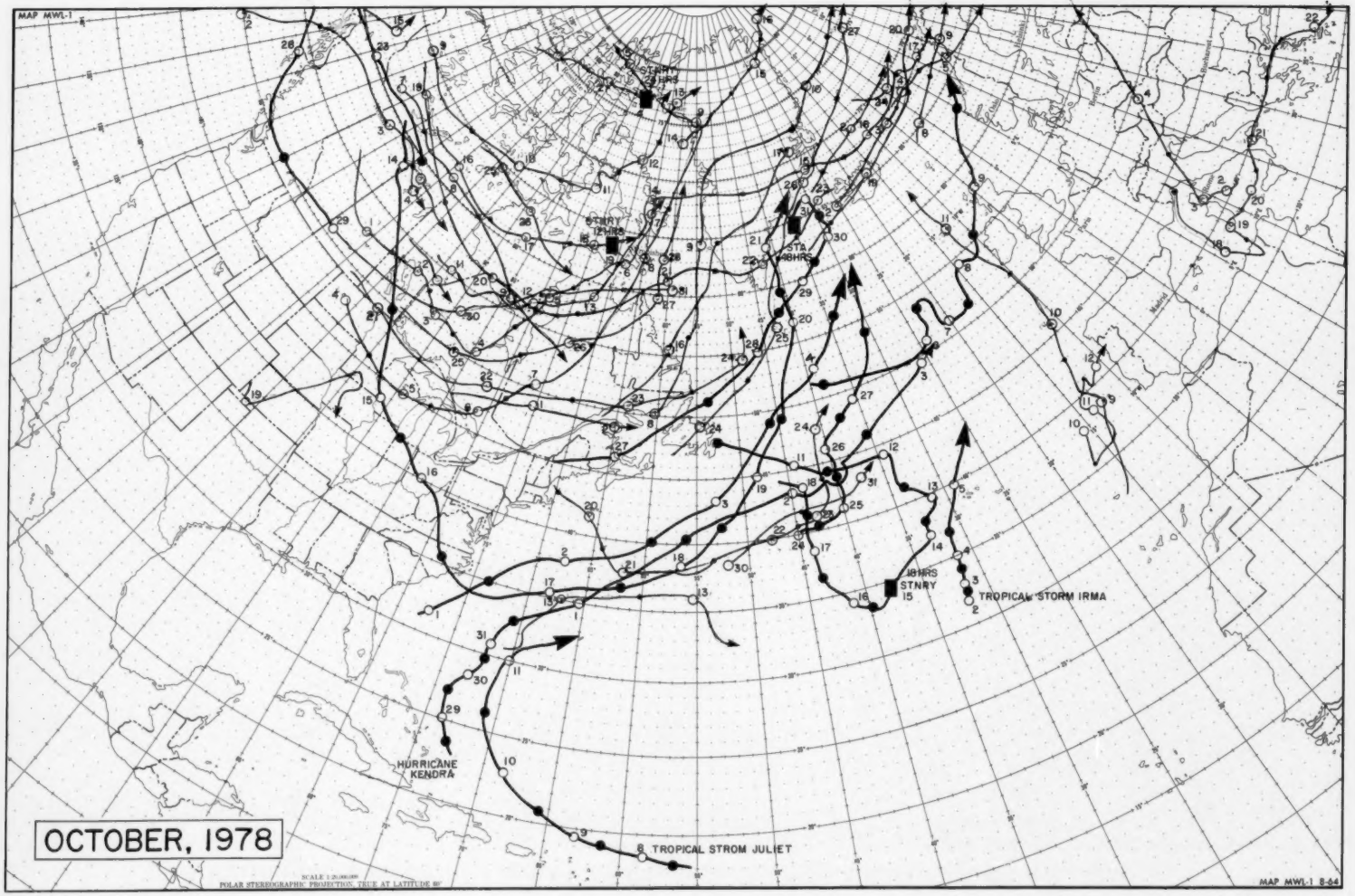



Figure 44. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

# Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

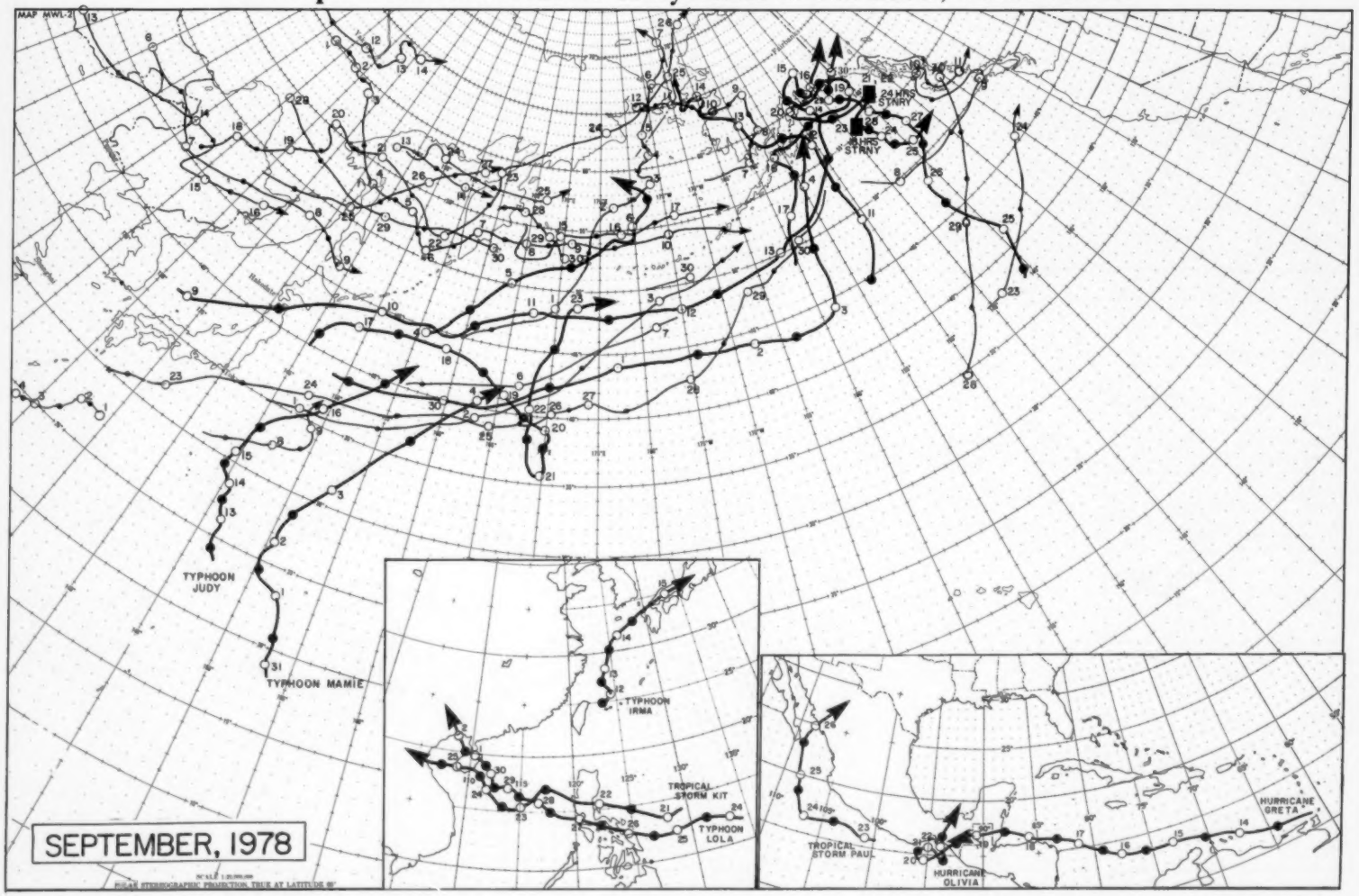



Figure 45. -- Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

# Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

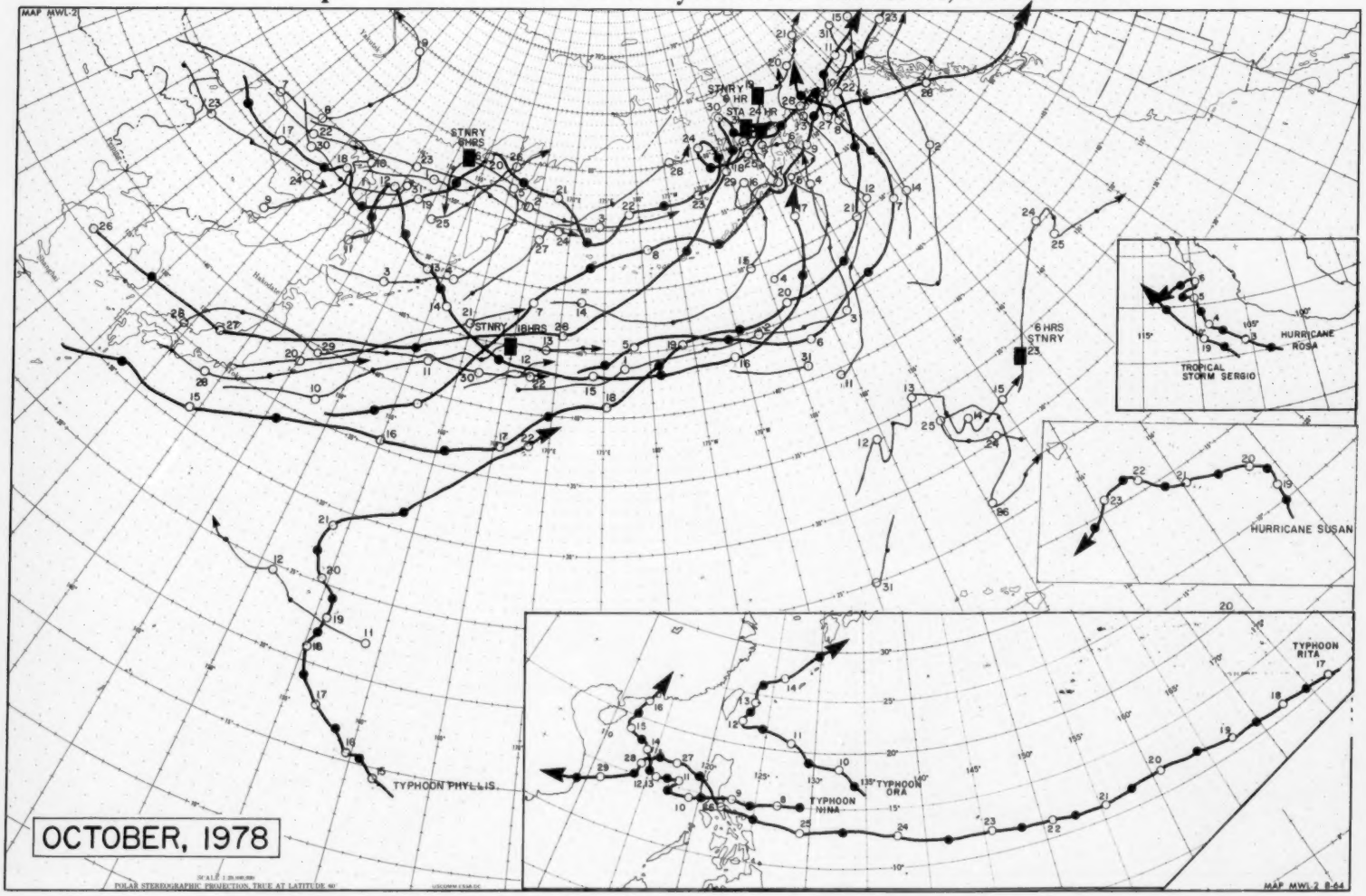
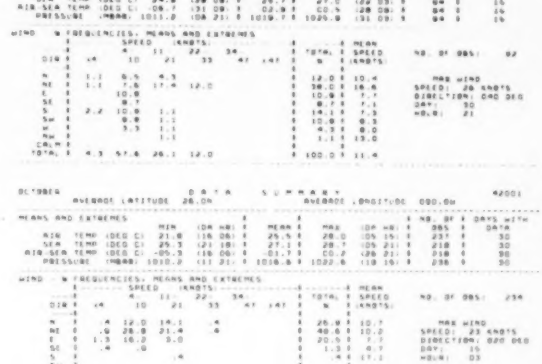
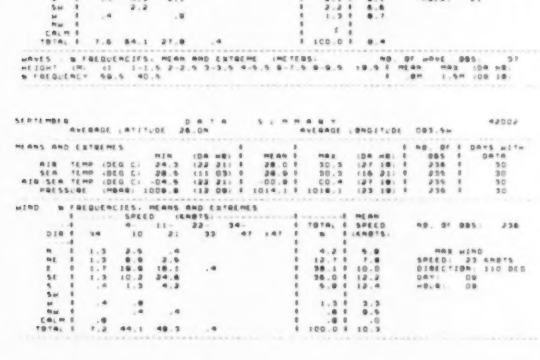


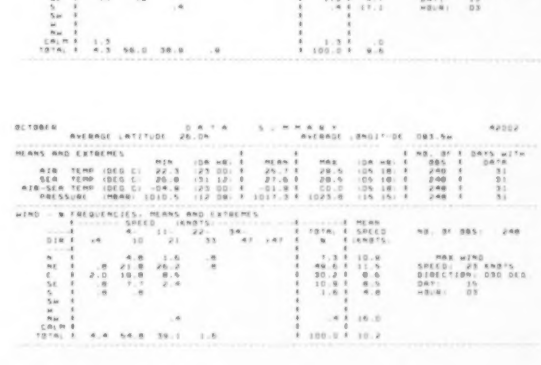

Figure 46. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

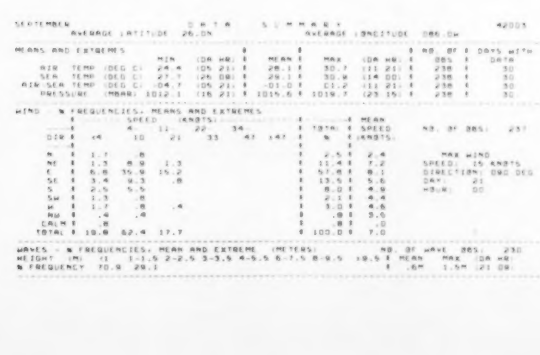
# U.S. Ocean Buoy Climatological Data

## September and October 1978









SEPTEMBER DATA SUMMARY 44001
AVERAGE LATITUDE 38.7N AVERAGE LONGITUDE 073.8W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 14.1 | (28 15) | 20.2 | 25.9 | (07 21) | 238 | 30 |
| SEA TEMP (DEG C) | 17.4 | (20 15) | 21.2 | 25.0 | (06 18) | 238 | 30 |
| AIR-SEA TEMP (DEG C) | -04.1 | (20 09) | -01.0 | 02.2 | (18 12) | 238 | 30 |
| PRESSURE (MBAR) | 1008.4 | (09 09) | 1017.7 | 1027.3 | (23 15) | 238 | 30 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | | | | | | MEAN | NO. OF OBS: 238 |
|---|---|---|---|---|---|---|---|
| DIR | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | SPEED (KNOTS) | |
| N | | .8 | 4.2 | 6.3 | | | 11.3 | 10.5 | MAX WIND |
| NE | | .8 | 7.6 | 10.9 | .4 | | 25.0 | 13.1 | SPEED: 23 KNOTS |
| E | | .4 | 11.8 | 3.4 | | | 15.5 | 9.8 | DIRECTION: 050 DEG |
| SE | | .4 | 2.5 | | | | 3.4 | 5.8 | DAY: 23 |
| S | | .4 | 2.9 | 2.5 | | | 5.9 | 8.5 | HOUR: 08 |
| SW | | 2.1 | 10.5 | 7.6 | .4 | | 20.5 | 9.9 | |
| W | | 2.1 | 8.4 | 1.7 | | | 12.2 | 7.4 | |
| NW | | .4 | 2.9 | 1.3 | | | 4.6 | 8.4 | |
| CALM | 4.6 | | | | | | 4.6 | .0 | |
| TOTAL % | 5.0 | 9.8 | 39.6 | .8 | | | 100.0 | 10.8 | |

SEPTEMBER DATA SUMMARY 44003
AVERAGE LATITUDE 40.8N AVERAGE LONGITUDE 068.5W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 12.0 | (25 09) | 14.8 | 18.8 | (01 00) | 211 | 30 |
| SEA TEMP (DEG C) | 13.2 | (30 03) | 14.3 | 15.6 | (10 03) | 205 | 30 |
| AIR-SEA TEMP (DEG C) | -03.5 | (15 06) | 00.3 | 04.0 | (07 09) | 204 | 30 |
| PRESSURE (MBAR) | 1004.4 | (07 12) | 1018.3 | 1031.5 | (30 15) | 211 | 30 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | | | | | | MEAN | NO. OF OBS: 211 |
|---|---|---|---|---|---|---|---|
| DIR | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | SPEED (KNOTS) | |
| N | | | 8.5 | 10.9 | 1.4 | | 20.9 | 12.7 | MAX WIND |
| NE | | 1.4 | 8.6 | 15.3 | .5 | | 21.0 | 12.7 | SPEED: 28 KNOTS |
| E | | 3.8 | 7.6 | 4.7 | | | 16.1 | 7.8 | DIRECTION: 340 DEG |
| SE | | .5 | 5.3 | | | | 5.8 | 7.4 | DAY: 09 |
| S | | .9 | 4.7 | 4.3 | | | 10.0 | 9.4 | HOUR: 21 |
| SW | | .9 | 8.1 | 6.6 | | | 15.6 | 10.3 | |
| W | | | 5.2 | .9 | | | 6.2 | 7.2 | |
| NW | | .9 | 1.4 | 1.8 | .5 | | 4.7 | 10.8 | |
| CALM | | .0 | | | | | .0 | .0 | |
| TOTAL | 0.5 | 45.5 | 42.7 | 2.4 | | | 100.0 | 10.9 | |

SEPTEMBER DATA SUMMARY 44004
AVERAGE LATITUDE 38.0N AVERAGE LONGITUDE 070.0W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 19.2 | (29 12) | 21.5 | 25.5 | (01 00) | 238 | 30 |
| SEA TEMP (DEG C) | 25.2 | (30 12) | 25.5 | 27.3 | (15 21) | 238 | 30 |
| AIR-SEA TEMP (DEG C) | -09.8 | (10 12) | -04.2 | 00.6 | (12 12) | 238 | 30 |
| PRESSURE (MBAR) | 1006.8 | (09 09) | 1017.0 | 1029.2 | (30 15) | 238 | 30 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | | | | | | MEAN | NO. OF OBS: 239 |
|---|---|---|---|---|---|---|---|
| DIR | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | SPEED (KNOTS) | |
| N | | .4 | 2.5 | 14.6 | 4.2 | | 21.8 | 16.0 | MAX WIND |
| NE | | | 2.5 | 11.7 | 7.1 | | 21.3 | 16.7 | SPEED: 30 KNOTS |
| E | | .8 | 4.2 | 5.0 | | | 10.0 | 10.5 | DIRECTION: 030 DEG |
| SE | | | .8 | | | | .8 | 7.3 | DAY: 23 |
| S | | | 2.9 | 2.9 | .8 | | 6.7 | 12.0 | HOUR: 09 |
| SW | | .4 | 3.3 | 11.7 | 3.8 | | 19.2 | 18.0 | |
| W | | 1.3 | 4.6 | 6.0 | | | 11.9 | 11.2 | |
| NW | | .4 | 2.5 | 2.9 | 1.3 | | 7.1 | 13.2 | |
| CALM | | 1.3 | | | | | 1.3 | .0 | |
| TOTAL | | 4.6 | 23.4 | 54.0 | 18.0 | | 100.0 | 14.9 | |

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 236

| HEIGHT (M) | <1 | 1-1.9 | 2-2.5 | 3-3.5 | 4-5.5 | 6-7.5 | 8-9.5 | >9.5 | MEAN | MAX (DA HR) |
|---|---|---|---|---|---|---|---|---|---|---|
| % FREQUENCY | | 63.6 | 28.2 | 7.2 | | | | | 1.7M | 3.5M (20 03) |

SEPTEMBER DATA SUMMARY 46001
AVERAGE LATITUDE 55.0N AVERAGE LONGITUDE 148.0W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 09.5 | (27 12) | 10.8 | 11.5 | (28 12) | 54 | 7 |
| SEA TEMP (DEG C) | 10.8 | (28 12) | 11.5 | 12.5 | (25 03) | 55 | 7 |
| AIR-SEA TEMP (DEG C) | -01.3 | (27 21) | -00.2 | 00.8 | (28 12) | 54 | 7 |
| PRESSURE (MBAR) | 0998.3 | (28 15) | 1011.2 | 1023.8 | (25 21) | 55 | 7 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | | | | | | MEAN | NO. OF OBS: 55 |
|---|---|---|---|---|---|---|---|
| DIR | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | SPEED (KNOTS) | |
| N | | 1.8 | 9.1 | 29.1 | | | 40.0 | 12.8 | MAX WIND |
| NE | | | 5.5 | 10.9 | | | 16.4 | 11.2 | SPEED: 30 KNOTS |
| E | | | 7.3 | | | | 7.3 | 8.0 | DIRECTION: 020 DEG |
| SE | | 3.6 | | | | | 3.6 | 3.0 | DAY: 28 |
| S | | 9.1 | | | | | 9.1 | 2.4 | HOUR: 15 |
| SW | | | | 1.8 | | | 1.8 | 11.0 | |
| W | | | | 10.2 | | | 10.2 | 15.0 | |
| NW | | 1.8 | | 5.5 | | | 7.3 | 10.8 | |
| CALM | | | | | | | .0 | .0 | |
| TOTAL | | 12.7 | 21.8 | 55.5 | | | 100.0 | 11.4 | |

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 54

| HEIGHT (M) | <1 | 1-1.5 | 2-2.5 | 3-3.5 | 4-5.5 | 6-7.5 | 8-9.5 | >9.5 | MEAN | MAX (DA HR) |
|---|---|---|---|---|---|---|---|---|---|---|
| % FREQUENCY | | 27.8 | 59.3 | 13.0 | | | | | 1.1M | 2.5M (28 15) |

SEPTEMBER DATA SUMMARY 48002
AVERAGE LATITUDE 42.5N AVERAGE LONGITUDE 130.0W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 14.0 | (18 09) | 16.8 | 18.7 | (01 06) | 234 | 30 |
| SEA TEMP (DEG C) | 16.0 | (27 15) | 18.3 | 19.1 | (05 00) | 235 | 30 |
| AIR-SEA TEMP (DEG C) | -03.0 | (18 09) | -01.5 | 00.4 | (28 12) | 234 | 30 |
| PRESSURE (MBAR) | 0993.7 | (09 12) | 1017.2 | 1030.9 | (15 21) | 235 | 30 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | | | | | | MEAN | NO. OF OBS: 235 |
|---|---|---|---|---|---|---|---|
| DIR | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | SPEED (KNOTS) | |
| N | | | 7.7 | 14.5 | 1.7 | | 23.8 | 13.2 | MAX WIND |
| NE | | | .4 | | | | .4 | 8.0 | SPEED: 28 KNOTS |
| E | | | | | | | | | DIRECTION: 180 DEG |
| SE | | | 2.1 | .9 | .4 | | 3.4 | 11.3 | DAY: 26 |
| S | | 1.3 | 4.3 | 3.9 | 1.3 | | 10.6 | 12.5 | HOUR: 12 |
| SW | | .4 | 5.8 | 17.4 | .4 | | 24.1 | 14.8 | |
| W | | .9 | 6.8 | 15.2 | | | 23.0 | 12.4 | |
| NW | | 1.3 | 5.1 | 8.9 | .4 | | 15.7 | 12.0 | |
| CALM | | | | | | | .4 | .0 | |
| TOTAL | | 3.8 | 30.2 | 61.7 | 4.3 | | 100.0 | 13.0 | |

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 235

| HEIGHT (M) | <1 | 1-1.5 | 2-2.5 | 3-3.5 | 4-5.5 | 6-7.5 | 8-9.5 | >9.5 | MEAN | MAX (DA HR) |
|---|---|---|---|---|---|---|---|---|---|---|
| % FREQUENCY | | 40.4 | 24.5 | 11.1 | | | | | 2.0M | 3.5M (28 00) |

SEPTEMBER DATA SUMMARY 48004
AVERAGE LATITUDE 51.0N AVERAGE LONGITUDE 138.0W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 08.5 | (23 18) | 12.5 | 14.4 | (19 09) | 102 | 13 |
| SEA TEMP (DEG C) | 13.1 | (22 15) | 13.5 | 15.1 | (29 00) | 102 | 13 |
| AIR-SEA TEMP (DEG C) | -03.8 | (23 18) | -01.2 | 00.8 | (19 09) | 102 | 13 |
| PRESSURE (MBAR) | 0983.2 | (27 00) | 1010.0 | 1028.5 | (18 00) | 102 | 13 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | | | | | | MEAN | NO. OF OBS: 102 |
|---|---|---|---|---|---|---|---|
| DIR | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | SPEED (KNOTS) | |
| N | | 1.0 | | 1.0 | | | 2.0 | 13.5 | MAX WIND |
| NE | | | 1.0 | 2.0 | 4.9 | | 7.8 | 21.0 | SPEED: 33 KNOTS |
| E | | | | 2.0 | 8.8 | | 10.8 | 25.0 | DIRECTION: 320 DEG |
| SE | | | 1.0 | 2.0 | | | 2.9 | 9.7 | DAY: 28 |
| S | | 1.0 | 2.0 | 5.9 | 10.8 | | 20.6 | 19.5 | HOUR: 08 |
| SW | | 1.0 | 2.0 | 17.6 | 5.8 | | 27.5 | 17.5 | |
| W | | | 1.0 | 14.7 | 8.8 | | 24.5 | 18.4 | |
| NW | | | 1.0 | 1.0 | 3.9 | | 5.9 | 24.0 | |
| CALM | | 1.0 | | | | | 1.0 | .0 | |
| TOTAL | | 3.9 | 8.8 | 44.1 | 43.1 | | 100.0 | 18.9 | |

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 102

| HEIGHT (M) | <1 | 1-1.9 | 2-2.5 | 3-3.5 | 4-5.5 | 6-7.5 | 8-9.5 | >9.5 | MEAN | MAX (DA HR) |
|---|---|---|---|---|---|---|---|---|---|---|
| % FREQUENCY | | 20.6 | 51.0 | 20.4 | | | | | 2.4M | 3.5M (27 18) |

OCTOBER DATA SUMMARY 44001
AVERAGE LATITUDE 38.7N AVERAGE LONGITUDE 073.6W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 08.1 | (24 15) | 15.5 | 19.4 | (05 21) | 248 | 31 |
| SEA TEMP (DEG C) | 14.6 | (31 15) | 18.6 | 19.7 | (03 18) | 248 | 31 |
| AIR-SEA TEMP (DEG C) | -07.1 | (08 15) | -01.3 | 02.6 | (27 03) | 248 | 31 |
| PRESSURE (MBAR) | 1007.0 | (06 21) | 1018.7 | 1034.3 | (30 15) | 248 | 31 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | | | | | | MEAN | NO. OF OBS: 248 |
|---|---|---|---|---|---|---|---|
| DIR | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | SPEED (KNOTS) | |
| N | | 1.6 | 6.0 | 7.3 | 1.2 | | 16.1 | 11.6 | MAX WIND |
| NE | | .8 | 4.4 | 7.7 | 1.2 | | 14.1 | 13.7 | SPEED: 27 KNOTS |
| E | | .8 | 4.0 | 4.4 | .4 | | 10.5 | 10.1 | DIRECTION: 350 DEG |
| SE | | | 3.6 | 1.2 | | | 4.8 | 7.0 | DAY: 24 |
| S | | .8 | 5.2 | 4.0 | | | 10.1 | 8.5 | HOUR: 08 |
| SW | | .8 | 2.4 | 11.7 | .8 | | 15.7 | 13.2 | |
| W | | 1.2 | 6.0 | 4.4 | | | 11.7 | 9.3 | |
| NW | | .4 | 3.2 | 10.5 | .4 | | 14.5 | 14.2 | |
| CALM | 2.4 | | | | | | 2.4 | .0 | |
| TOTAL | 5.0 | 5.9 | 35.9 | 51.2 | 4.0 | | 100.0 | 11.3 | |

OCTOBER DATA SUMMARY 44003
AVERAGE LATITUDE 40.8N AVERAGE LONGITUDE 068.5W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 06.3 | (25 00) | 12.6 | 17.2 | (15 03) | 244 | 31 |
| SEA TEMP (DEG C) | 12.3 | (31 03) | 13.2 | 14.0 | (01 12) | 241 | 31 |
| AIR-SEA TEMP (DEG C) | -00.8 | (25 03) | -00.6 | 04.4 | (15 03) | 241 | 31 |
| PRESSURE (MBAR) | 1005.3 | (15 03) | 1018.7 | 1037.7 | (31 00) | 244 | 31 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | | | | | | MEAN | NO. OF OBS: 244 |
|---|---|---|---|---|---|---|---|
| DIR | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | SPEED (KNOTS) | |
| N | | 2.0 | 3.3 | 11.9 | 1.2 | | 18.4 | 13.3 | MAX WIND |
| NE | | | 1.6 | 4.6 | | | 6.1 | 12.8 | SPEED: 24 KNOTS |
| E | | | 4.9 | 4.0 | .4 | | 15.2 | 12.1 | DIRECTION: 340 DEG |
| SE | | .4 | 4.8 | 2.9 | | | 8.2 | 9.3 | DAY: 24 |
| S | | .8 | 5.3 | 4.1 | .4 | | 10.7 | 10.6 | HOUR: 09 |
| SW | | .8 | 5.3 | 4.9 | | | 11.1 | 11.7 | |
| W | | .4 | 9.3 | 11.9 | | | 17.6 | 12.6 | |
| NW | | .4 | 9.3 | 7.0 | | | 12.7 | 11.5 | |
| CALM | | | | | | | | | |
| TOTAL | 4.0 | 32.4 | 60.7 | 2.8 | | | 100.0 | 11.9 | |

OCTOBER DATA SUMMARY 44004
AVERAGE LATITUDE 39.0N AVERAGE LONGITUDE 070.0W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 09.7 | (25 00) | 17.3 | 24.0 | (06 12) | 243 | 31 |
| SEA TEMP (DEG C) | 18.0 | (21 21) | 21.5 | 24.9 | (02 15) | 244 | 31 |
| AIR-SEA TEMP (DEG C) | -10.9 | (09 06) | -04.1 | 01.2 | (27 06) | 243 | 31 |
| PRESSURE (MBAR) | 1006.8 | (09 09) | 1019.1 | 1035.7 | (30 21) | 244 | 31 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | | | | | | MEAN | NO. OF OBS: 244 |
|---|---|---|---|---|---|---|---|
| DIR | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | SPEED (KNOTS) | |
| N | | | .4 | 4.1 | 11.5 | 5.7 | 21.7 | 16.7 | MAX WIND |
| NE | | | .4 | 2.0 | 7.4 | 3.3 | 13.1 | 15.9 | SPEED: 31 KNOTS |
| E | | | .4 | 4.5 | 9.0 | .8 | 14.8 | 12.5 | DIRECTION: 310 DEG |
| SE | | | .8 | 1.2 | 8.2 | 1.2 | 11.4 | 10.4 | DAY: 09 |
| S | | | | 2.9 | 2.5 | 1.6 | 7.0 | 15.5 | HOUR: 09 |
| SW | | | | | 7.0 | 2.9 | 9.9 | 18.1 | |
| W | | | 2.5 | 10.7 | 11.2 | 2.0 | 25.2 | 14.5 | |
| NW | | | | 7.1 | 13.2 | | 13.5 | 16.8 | |
| CALM | | | | 1.3 | .0 | | 1.3 | .0 | |
| TOTAL | | 2.9 | 10.8 | 57.8 | 20.5 | | 100.0 | 15.5 | |

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 240

| HEIGHT (M) | <1 | 1-1.5 | 2-2.5 | 3-3.5 | 4-5.5 | 6-7.5 | 8-9.5 | >9.5 | MEAN | MAX (DA HR) |
|---|---|---|---|---|---|---|---|---|---|---|
| % FREQUENCY | | 54.6 | 37.5 | 7.9 | | | | | 1.8M | 3.5M (17 21) |

OCTOBER DATA SUMMARY 46001
AVERAGE LATITUDE 58.0N AVERAGE LONGITUDE 148.0W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS W. H DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 07.7 | (08 15) | 10.0 | 11.4 | (05 06) | 75 | 10 |
| SEA TEMP (DEG C) | 08.8 | (08 03) | 10.6 | 12.0 | (09 09) | 75 | 10 |
| AIR-SEA TEMP (DEG C) | -05.6 | (08 06) | -00.6 | 01.0 | (05 06) | 75 | 10 |
| PRESSURE (MBAR) | 0988.3 | (08 06) | 0985.5 | 1014.4 | (03 21) | 75 | 10 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | | | | | | MEAN | NO. OF OBS: 75 |
|---|---|---|---|---|---|---|---|
| DIR | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | SPEED (KNOTS) | |
| N | | | | 1.9 | | | 1.9 | 29.0 | MAX WIND |
| NE | | | 1.3 | 2.7 | | | 4.0 | 15.3 | SPEED: 42 KNOTS |
| E | | | 2.7 | 1.3 | | | 4.0 | 14.5 | DIRECTION: 270 DEG |
| SE | | | | 4.0 | 8.0 | | 12.0 | 23.3 | DAY: 08 |
| S | | | 2.7 | 22.7 | 14.7 | | 40.0 | 19.8 | HOUR: 15 |
| SW | | | | 8.5 | 12.0 | | 20.5 | 20.8 | |
| W | | | | 6.7 | 4.0 | 4.0 | 14.7 | 27.0 | |
| NW | | | 1.3 | | | | 1.3 | 7.0 | |
| CALM | | | | | | | | | |
| TOTAL | | | 8.0 | 48.7 | 41.3 | 4.0 | 100.0 | 20.8 | |

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 42

| HEIGHT (M) | <1 | 1-1.9 | 2-2.5 | 3-3.9 | 4-5.5 | 6-7.5 | 8-9.5 | >9.5 | MEAN | MAX (DA HR) |
|---|---|---|---|---|---|---|---|---|---|---|
| % FREQUENCY | 2.4 | 40.5 | 19.0 | 28.2 | 11.9 | | | | 2.5M | 4.5M (05 03) |

OCTOBER DATA SUMMARY 48002
AVERAGE LATITUDE 42.5N AVERAGE LONGITUDE 130.0W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 13.0 | (29 03) | 15.9 | 18.3 | (08 09) | 246 | 31 |
| SEA TEMP (DEG C) | 16.6 | (31 12) | 17.6 | 18.1 | (22 00) | 246 | 31 |
| AIR-SEA TEMP (DEG C) | -01.0 | (29 03) | -01.7 | 00.3 | (08 18) | 246 | 31 |
| PRESSURE (MBAR) | 1011.0 | (08 00) | 1021.0 | 1031.5 | (30 18) | 246 | 31 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | | | | | | MEAN | NO. OF OBS: 246 |
|---|---|---|---|---|---|---|---|
| DIR | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | SPEED (KNOTS) | |
| N | | .4 | 14.2 | 18.1 | 1.2 | | 34.0 | 11.4 | MAX WIND |
| NE | | | 5.7 | 14.6 | 3.3 | | 23.6 | 15.1 | SPEED: 30 KNOTS |
| E | | .4 | | 1.6 | | | 1.9 | 8.0 | DIRECTION: 330 DEG |
| SE | | | .4 | | | | .4 | 6.0 | DAY: 30 |
| S | | | 2.8 | 5.7 | .4 | | 8.8 | 12.7 | HOUR: 00 |
| SW | | | 4.5 | 4.5 | | | 8.8 | 10.5 | |
| W | | .4 | 2.8 | 3.7 | .4 | | 7.3 | 10.9 | |
| NW | | .4 | 5.7 | 5.3 | 2.4 | | 13.8 | 13.1 | |
| CALM | | .4 | | | | | .4 | .0 | |
| TOTAL | | 2.0 | 37.0 | 53.9 | 7.7 | | 100.0 | 12.4 | |

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 246

| HEIGHT (M) | <1 | 1-1.9 | 2-2.5 | 3-3.5 | 4-5.5 | 6-7.5 | 8-9.5 | >9.5 | MEAN | MAX (DA HR) |
|---|---|---|---|---|---|---|---|---|---|---|
| % FREQUENCY | | 41.9 | 15.9 | .8 | | | | | 2.0M | 4.0M (09 15) |

OCTOBER DATA SUMMARY 46004
AVERAGE LATITUDE 51.0N AVERAGE LONGITUDE 136.0W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 06.8 | (28 12) | 11.6 | 13.9 | (06 03) | 247 | 31 |
| SEA TEMP (DEG C) | 11.4 | (31 21) | 12.3 | 13.5 | (04 00) | 247 | 31 |
| AIR-SEA TEMP (DEG C) | -04.9 | (28 12) | -00.8 | 01.2 | (13 12) | 247 | 31 |
| PRESSURE (MBAR) | 0994.7 | (08 00) | 1017.0 | 1030.2 | (12 00) | 247 | 31 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | | | | | | MEAN | NO. OF OBS: 247 |
|---|---|---|---|---|---|---|---|
| DIR | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | SPEED (KNOTS) | |
| N | | | | 1.2 | .4 | | 1.6 | 20.0 | MAX WIND |
| NE | | .4 | | .4 | | | 1.2 | 7.7 | SPEED: 44 KNOTS |
| E | | | | .4 | | | .4 | 12.5 | DIRECTION: 180 DEG |
| SE | | .4 | | 2.4 | .4 | .8 | 4.0 | 21.0 | DAY: 31 |
| S | | | 1.6 | 10.6 | 14.2 | 3.6 | 30.1 | 22.3 | HOUR: 00 |
| SW | | | 1.6 | 13.4 | 7.7 | .4 | 23.1 | 19.2 | |
| W | | | 2.4 | 13.0 | 8.8 | | 24.3 | 19.1 | |
| NW | | | .8 | 3.6 | 2.4 | | 6.9 | 18.9 | |
| CALM | | | | | | | | | |
| TOTAL | | .8 | 6.9 | 53.4 | 34.0 | 4.9 | 100.0 | 20.2 | |

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 247

| HEIGHT (M) | <1 | 1-1.9 | 2-2.5 | 3-3.5 | 4-5.5 | 6-7.5 | 8-9.5 | >9.5 | MEAN | MAX (DA HR) |
|---|---|---|---|---|---|---|---|---|---|---|
| % FREQUENCY | | 13.0 | 40.5 | 25.9 | 17.0 | 3.6 | | | 2.8M | 7.5M (31 06) |

SEPTEMBER D A T A S U M M A R Y 46005
AVERAGE LATITUDE 46.0N AVERAGE LONGITUDE 131.0W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 12.9 | (22 06) | 15.1 | 17.2 | (12 18) | 235 | 30 |
| SEA TEMP (DEG C) | 15.0 | (30 12) | 15.9 | 17.2 | (12 00) | 234 | 30 |
| AIR-SEA TEMP (DEG C) | -02.6 | (22 06) | -00.8 | C1.2 | (24 15) | 234 | 30 |
| PRESSURE (MBAR) | 0982.0 | (09 03) | 1015.1 | 1031.0 | (16 00) | 235 | 30 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | MEAN SPEED (KNOTS) |
|---|---|---|---|---|---|---|---|---|
| DIR | | | | | | | | |
| N | | | 1.7 | 5.5 | 2.6 | | 9.8 | 16.7 |
| NE | | | .4 | | | | .4 | 7.0 |
| E | | | 1.3 | 1.7 | | | 3.0 | 13.2 |
| SE | | | .9 | 3.0 | 1.7 | .4 | 6.0 | 18.6 |
| S | | .4 | 4.3 | 8.8 | 6.8 | .4 | 18.7 | 18.0 |
| SW | | .9 | 4.3 | 10.2 | 2.6 | | 17.9 | 14.8 |
| W | | .9 | 6.8 | 14.5 | 3.0 | | 25.1 | 14.2 |
| NW | | | .9 | 15.7 | 2.6 | | 19.1 | 17.3 |
| CALM | | | | | | | | |
| TOTAL % | 2.1 | 20.4 | 57.4 | 10.1 | .9 | | 100.0 | 16.1 |

MEAN WIND SPEED: 40 KNOTS
DIRECTION: 330 DEG
DAY: 28
HOUR: 12

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 235

| HEIGHT (M) | <1 | 1-1.5 | 2-2.5 | 3-3.5 | 4-5.5 | 6-7.5 | 8-9.5 | >9.5 | MEAN | MAX | (DA HR) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| % FREQUENCY | | 38.5 | 38.5 | 20.9 | 1.3 | | | | 2.1M | 4.5M | (28 15) |

SEPTEMBER D A T A S U M M A R Y 46006
AVERAGE LATITUDE 41.0N AVERAGE LONGITUDE 130.0W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 13.9 | (02 15) | 16.7 | 19.3 | (01 03) | 239 | 30 |
| SEA TEMP (DEG C) | 17.1 | (09 12) | 17.8 | 19.3 | (01 03) | 238 | 30 |
| AIR-SEA TEMP (DEG C) | -04.6 | (02 15) | -01.2 | C1.2 | (28 03) | 238 | 30 |
| PRESSURE (MBAR) | 1000.4 | (26 03) | 1019.6 | 1035.2 | (16 21) | 238 | 30 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | MEAN SPEED (KNOTS) |
|---|---|---|---|---|---|---|---|---|
| DIR | | | | | | | | |
| N | | 1.7 | 2.9 | 5.9 | .8 | | 11.3 | 10.8 |
| NE | | | 6.7 | .8 | .4 | | 7.9 | 9.9 |
| E | | 2.1 | 1.3 | .8 | | | 4.2 | 8.2 |
| SE | | .4 | 1.3 | .8 | | | 2.5 | 9.0 |
| S | | .8 | 2.1 | 5.0 | 3.5 | | 11.4 | 16.5 |
| SW | | .4 | 1.3 | 7.9 | 2.9 | | 12.5 | 15.6 |
| W | | 1.3 | 3.8 | 21.3 | 6.3 | | 32.6 | 16.3 |
| NW | | | 2.5 | 11.3 | 2.5 | | 16.3 | 15.3 |
| CALM | | .4 | | | | | .4 | 0 |
| TOTAL % | | 7.1 | 21.8 | 54.8 | 16.9 | | 100.0 | 14.9 |

MEAN WIND SPEED: 32 KNOTS
DIRECTION: 300 DEG
DAY: 27
HOUR: 21

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 239

| HEIGHT (M) | <1 | 1-1.5 | 2-2.5 | 3-3.5 | 4-5.5 | 6-7.5 | 8-9.5 | >9.5 | MEAN | MAX | (DA HR) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| % FREQUENCY | | .4 | 35.8 | 40.6 | 11.7 | 2.5 | | | 2.0M | 4.0M | (28 21) |

SEPTEMBER D A T A S U M M A R Y 46007
AVERAGE LATITUDE 50.2N AVERAGE LONGITUDE 152.7W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 09.6 | (28 18) | 10.2 | 12.8 | (09 03) | 193 | 30 |
| SEA TEMP (DEG C) | 08.9 | (18 15) | 10.8 | 12.8 | (09 03) | 192 | 30 |
| AIR-SEA TEMP (DEG C) | -04.6 | (22 18) | -00.6 | C1.7 | (09 03) | 192 | 30 |
| PRESSURE (MBAR) | 0980.9 | (13 06) | 1004.0 | 1024.2 | (17 09) | 193 | 30 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | MEAN SPEED (KNOTS) |
|---|---|---|---|---|---|---|---|---|
| DIR | | | | | | | | |
| N | | 1.0 | 4.2 | .5 | | | 5.7 | 6.2 |
| NE | | 1.0 | 4.2 | 4.7 | .5 | | 10.4 | 11.4 |
| E | | 1.6 | 5.1 | 3.1 | 1.0 | | 10.9 | 11.4 |
| SE | | .5 | 4.2 | 12.5 | | | 17.2 | 12.3 |
| S | | 1.6 | 4.7 | 4.7 | | | 11.0 | 9.9 |
| SW | | .5 | 2.6 | | | | 3.1 | 4.8 |
| W | | 1.0 | 8.9 | 10.8 | 4.2 | | 32.8 | 13.9 |
| NW | | 2.1 | 8.8 | 2.1 | | | 13.0 | 7.4 |
| CALM | | | | | | | | |
| TOTAL % | | 8.4 | 38.9 | 48.4 | 5.7 | | 100.0 | 11.1 |

MEAN WIND SPEED: 28 KNOTS
DIRECTION: 280 DEG
DAY: 16
HOUR: 21

SEPTEMBER D A T A S U M M A R Y 46008
AVERAGE LATITUDE 57.1N AVERAGE LONGITUDE 151.7W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 07.8 | (23 09) | 09.5 | 11.9 | (09 03) | 108 | 18 |
| SEA TEMP (DEG C) | 07.4 | (30 15) | 08.3 | 10.5 | (01 09) | 106 | 18 |
| AIR-SEA TEMP (DEG C) | -00.2 | (25 00) | 01.2 | C2.7 | (05 06) | 106 | 18 |
| PRESSURE (MBAR) | 0980.8 | (12 06) | 1008.5 | 1023.4 | (24 21) | 108 | 18 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | MEAN SPEED (KNOTS) |
|---|---|---|---|---|---|---|---|---|
| DIR | | | | | | | | |
| N | | .9 | 16.8 | 22.4 | | | 40.2 | 11.0 |
| NE | | 1.9 | 1.9 | .9 | | | 4.6 | 7.6 |
| E | | | .9 | | | | .9 | 5.0 |
| SE | | 3.7 | | .9 | | | 4.6 | 4.2 |
| S | | .9 | 2.8 | 1.9 | | | 5.6 | 9.7 |
| SW | | .9 | 15.0 | 2.8 | | | 18.7 | 8.0 |
| W | | 1.9 | 9.4 | 8.4 | | | 19.8 | 11.9 |
| NW | | .9 | 3.7 | 1.9 | | | 6.5 | 9.7 |
| CALM | | | | | | | | |
| TOTAL % | | 11.2 | 47.7 | 40.2 | .9 | | 100.0 | 9.9 |

MEAN WIND SPEED: 22 KNOTS
DIRECTION: 040 DEG
DAY: 12
HOUR: 06

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 89

| HEIGHT (M) | <1 | 1-1.5 | 2-2.5 | 3-3.5 | 4-5.5 | 6-7.5 | 8-9.5 | >9.5 | MEAN | MAX | (DA HR) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| % FREQUENCY | | 8.1 | 60.6 | 21.2 | 8.1 | 4.0 | | | 1.8M | 4.5M | (15 00) |

SEPTEMBER D A T A S U M M A R Y 46009
AVERAGE LATITUDE 60.2N AVERAGE LONGITUDE 146.8W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 11.2 | (06 12) | 12.4 | 13.8 | (02 03) | 64 | 10 |
| SEA TEMP (DEG C) | 13.5 | (10 18) | 13.8 | 14.1 | (03 21) | 65 | 10 |
| AIR-SEA TEMP (DEG C) | -02.0 | (06 18) | -00.8 | C0.3 | (02 03) | 64 | 10 |
| PRESSURE (MBAR) | 0988.9 | (10 06) | 1007.0 | 1021.1 | (05 03) | 64 | 10 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | MEAN SPEED (KNOTS) |
|---|---|---|---|---|---|---|---|---|
| DIR | | | | | | | | |
| N | | 13.8 | 3.4 | | | | 17.2 | 2.6 |
| NE | | 1.7 | 5.5 | 22.4 | | | 32.0 | 11.6 |
| E | | 3.4 | 6.0 | 6.0 | | | 17.2 | 8.7 |
| SE | | | 5.2 | | | | 5.2 | 9.0 |
| S | | 10.3 | | | | | 10.3 | 4.5 |
| SW | | 3.4 | 3.4 | | | | 6.9 | 3.3 |
| W | | 1.7 | | | | | 1.7 | 2.0 |
| NW | | 1.7 | | | | | 1.7 | 2.0 |
| CALM | | | | | | | | |
| TOTAL % | | 36.2 | 34.5 | 28.3 | | | 100.0 | 6.8 |

MEAN WIND SPEED: 18 KNOTS
DIRECTION: 090 DEG
DAY: 08
HOUR: 21

SEPTEMBER D A T A S U M M A R Y 46002
AVERAGE LATITUDE 40.3N AVERAGE LONGITUDE 073.0W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 18.3 | (08 12) | 21.2 | 24.0 | (07 21) | 88 | 10 |
| SEA TEMP (DEG C) | 21.8 | (10 00) | 22.7 | 24.1 | (03 21) | 87 | 10 |
| AIR-SEA TEMP (DEG C) | -05.8 | (08 12) | -01.4 | C1.0 | (07 21) | 87 | 10 |
| PRESSURE (MBAR) | 1008.0 | (04 06) | 1016.2 | 1023.6 | (02 12) | 87 | 10 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | MEAN SPEED (KNOTS) |
|---|---|---|---|---|---|---|---|---|
| DIR | | | | | | | | |
| N | | 1.6 | 8.4 | 8.4 | | | 20.3 | 9.3 |
| NE | | | 4.7 | 7.0 | | | 12.5 | 11.0 |
| E | | | 4.7 | | | | 4.7 | 7.0 |
| SE | | | 4.7 | 1.6 | | | 6.3 | 7.5 |
| S | | 1.6 | 3.1 | 4.7 | | | 9.4 | 9.9 |
| SW | | 3.1 | 9.4 | 6.3 | | | 18.8 | 10.4 |
| W | | 3.1 | 6.3 | 4.7 | | | 14.1 | 9.8 |
| NW | | | 4.7 | 9.4 | | | 14.1 | 11.1 |
| CALM | | | | | | | | |
| TOTAL % | | 8.4 | 46.8 | 43.8 | | | 100.0 | 9.9 |

MEAN WIND SPEED: 21 KNOTS
DIRECTION: 280 DEG
DAY: 08
HOUR: 08

OCTOBER D A T A S U M M A R Y 46005
AVERAGE LATITUDE 46.0N AVERAGE LONGITUDE 131.0W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 09.7 | (28 09) | 13.9 | 16.8 | (08 09) | 243 | 31 |
| SEA TEMP (DEG C) | 13.9 | (30 06) | 14.8 | 16.2 | (05 00) | 243 | 31 |
| AIR-SEA TEMP (DEG C) | -04.9 | (28 09) | -01.0 | C1.7 | (08 09) | 243 | 31 |
| PRESSURE (MBAR) | 1007.0 | (08 12) | 1022.4 | 1032.7 | (30 18) | 243 | 31 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | MEAN SPEED (KNOTS) |
|---|---|---|---|---|---|---|---|---|
| DIR | | | | | | | | |
| N | | 1.2 | 7.8 | 6.6 | 1.2 | | 16.8 | 11.8 |
| NE | | .8 | 2.5 | 9.1 | | | 12.3 | 13.2 |
| E | | 1.2 | 6.3 | 1.2 | | | 7.8 | 8.6 |
| SE | | 2.5 | 2.1 | 4.9 | | | 9.5 | 11.7 |
| S | | .4 | 4.5 | 11.8 | 2.9 | | 19.8 | 15.1 |
| SW | | .4 | 4.5 | 7.8 | 4.9 | | 17.7 | 14.8 |
| W | | .8 | 5.6 | 2.1 | .8 | | 10.1 | 8.9 |
| NW | | 1.2 | 4.1 | 5.8 | 4.1 | | 15.2 | 15.2 |
| CALM | | | | | | | | |
| TOTAL % | | 8.6 | 35.4 | 48.9 | 9.0 | | 100.0 | 12.4 |

MEAN WIND SPEED: 29 KNOTS
DIRECTION: 320 DEG
DAY: 28
HOUR: 21

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 243

| HEIGHT (M) | <1 | 1-1.5 | 2-2.5 | 3-3.5 | 4-5.5 | 6-7.5 | 8-9.5 | >9.5 | MEAN | MAX | (DA HR) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| % FREQUENCY | | 1.6 | 40.7 | 38.5 | 15.2 | 2.0 | | | 2.0M | 4.5M | (31 21) |

OCTOBER D A T A S U M M A R Y 46006
AVERAGE LATITUDE 41.0N AVERAGE LONGITUDE 130.0W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 12.8 | (29 18) | 16.7 | 19.8 | (07 21) | 248 | 31 |
| SEA TEMP (DEG C) | 17.0 | (31 18) | 17.6 | 19.2 | (05 00) | 248 | 31 |
| AIR-SEA TEMP (DEG C) | -04.6 | (29 18) | -01.0 | C1.1 | (07 21) | 248 | 31 |
| PRESSURE (MBAR) | 1008.5 | (08 03) | 1029.1 | 1038.1 | (28 18) | 248 | 31 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | MEAN SPEED (KNOTS) |
|---|---|---|---|---|---|---|---|---|
| DIR | | | | | | | | |
| N | | .4 | 2.4 | 7.7 | .4 | | 10.9 | 14.8 |
| NE | | .8 | 4.0 | 2.8 | | | 7.7 | 9.3 |
| E | | .8 | 2.4 | 11.3 | 1.2 | | 15.7 | 13.7 |
| SE | | | 2.0 | 2.0 | | | 4.0 | 10.5 |
| S | | .8 | 4.8 | 18.4 | 3.4 | | 27.4 | 14.8 |
| SW | | .4 | 6.5 | 5.6 | | | 12.5 | 12.5 |
| W | | .4 | 5.2 | 4.0 | | | 9.7 | 10.1 |
| NW | | .4 | 7.7 | 3.6 | .4 | | 12.1 | 9.5 |
| CALM | | | | | | | | |
| TOTAL % | | 4.0 | 35.1 | 58.6 | 4.4 | | 100.0 | 12.4 |

MEAN WIND SPEED: 26 KNOTS
DIRECTION: 300 DEG
DAY: 08
HOUR: 00

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 248

| HEIGHT (M) | <1 | 1-1.5 | 2-2.5 | 3-3.5 | 4-5.5 | 6-7.5 | 8-9.5 | >9.5 | MEAN | MAX | (DA HR) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| % FREQUENCY | | | 34.7 | 55.2 | 7.7 | 2.4 | | | 2.0M | 4.5M | (08 21) |

OCTOBER D A T A S U M M A R Y 46007
AVERAGE LATITUDE 50.2N AVERAGE LONGITUDE 152.7W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | -01.2 | (22 15) | 06.1 | 09.5 | (10 06) | 220 | 31 |
| SEA TEMP (DEG C) | 07.6 | (29 21) | 09.4 | 11.3 | (02 18) | 220 | 31 |
| AIR-SEA TEMP (DEG C) | -06.7 | (29 18) | -03.3 | C1.5 | (28 03) | 218 | 31 |
| PRESSURE (MBAR) | 0974.4 | (31 03) | 0997.4 | 1017.2 | (28 00) | 219 | 31 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | MEAN SPEED (KNOTS) |
|---|---|---|---|---|---|---|---|---|
| DIR | | | | | | | | |
| N | | .9 | 4.2 | 1.9 | .9 | | 7.9 | 10.5 |
| NE | | .5 | 4.2 | 6.1 | 2.3 | | 12.0 | 14.4 |
| E | | .9 | 3.7 | 4.2 | 2.3 | | 11.1 | 13.0 |
| SE | | | 5.6 | 9.7 | 3.2 | | 18.5 | 14.9 |
| S | | .5 | 3.7 | 4.6 | | | 8.8 | 10.1 |
| SW | | | 1.9 | 2.8 | | | 4.6 | 8.9 |
| W | | 2.3 | 2.3 | 19.0 | 7.4 | | 31.0 | 17.0 |
| NW | | .5 | 1.9 | 2.3 | | | 4.6 | 10.5 |
| CALM | | | | | | | .5 | .0 |
| TOTAL % | | 5.0 | 27.3 | 46.5 | 16.2 | | 100.0 | 13.8 |

MEAN WIND SPEED: 30 KNOTS
DIRECTION: 110 DEG
DAY: 17
HOUR: 03

OCTOBER D A T A S U M M A R Y 46008
AVERAGE LATITUDE 57.1N AVERAGE LONGITUDE 151.7W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 03.1 | (22 15) | 07.1 | 09.0 | (04 18) | 182 | 23 |
| SEA TEMP (DEG C) | 05.8 | (31 21) | 06.9 | 08.0 | (06 03) | 182 | 23 |
| AIR-SEA TEMP (DEG C) | -04.9 | (22 15) | -00.3 | C1.4 | (06 03) | 182 | 23 |
| PRESSURE (MBAR) | 0972.0 | (09 15) | 0997.6 | 1019.2 | (28 03) | 182 | 23 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | MEAN SPEED (KNOTS) |
|---|---|---|---|---|---|---|---|---|
| DIR | | | | | | | | |
| N | | 1.6 | 2.7 | 4.9 | | | 9.3 | 11.1 |
| NE | | 1.6 | 4.4 | 1.1 | | | 7.1 | 8.0 |
| E | | | 3.3 | 3.3 | | | 6.6 | 9.5 |
| SE | | .5 | 3.0 | 2.2 | | | 5.6 | 8.5 |
| S | | .5 | 4.9 | 6.9 | 2.7 | | 15.2 | 14.0 |
| SW | | | 3.3 | 10.4 | .5 | | 14.0 | 14.8 |
| W | | .5 | 8.0 | 14.8 | .5 | | 22.0 | 11.9 |
| NW | | 1.6 | 4.9 | 1.6 | | | 9.2 | 8.1 |
| CALM | | | | | | | .5 | .0 |
| TOTAL % | | 7.1 | 33.5 | 55.5 | 3.8 | | 100.0 | 11.8 |

MEAN WIND SPEED: 25 KNOTS
DIRECTION: 170 DEG
DAY: 03
HOUR: 12

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) NO. OF WAVE OBS: 180

| HEIGHT (M) | <1 | 1-1.5 | 2-2.5 | 3-3.5 | 4-5.5 | 6-7.5 | 8-9.5 | >9.5 | MEAN | MAX | (DA HR) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| % FREQUENCY | | 22.8 | 40.6 | 15.0 | 20.6 | 1.1 | | | 2.5M | 7.5M | (24 09) |

OCTOBER D A T A S U M M A R Y 46009
AVERAGE LATITUDE 60.0N AVERAGE LONGITUDE 146.8W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 02.2 | (31 15) | 05.6 | 08.7 | (30 00) | 57 | 8 |
| SEA TEMP (DEG C) | 06.8 | (30 06) | 08.4 | 10.0 | (01 18) | 57 | 8 |
| AIR-SEA TEMP (DEG C) | -05.7 | (31 15) | -02.7 | C0.4 | (30 00) | 57 | 8 |
| PRESSURE (MBAR) | 0977.8 | (31 05) | 0997.0 | 1014.7 | (28 09) | 57 | 8 |

WIND - % FREQUENCIES, MEANS AND EXTREMES

| SPEED (KNOTS) | <4 | 4-10 | 11-21 | 22-33 | 34-47 | >47 | TOTAL % | MEAN SPEED (KNOTS) |
|---|---|---|---|---|---|---|---|---|
| DIR | | | | | | | | |
| N | | 1.8 | 8.8 | 3.5 | | | 14.0 | 8.4 |
| NE | | | | | | | | |
| E | | | 12.3 | 15.8 | | | 28.1 | 12.3 |
| SE | | 1.8 | 7.0 | 5.3 | 3.5 | | 17.5 | 10.9 |
| S | | 1.8 | 14.0 | 10.5 | | | 26.3 | 11.8 |
| SW | | | 5.6 | 1.8 | | | 7.3 | 11.7 |
| W | | | | | | | | |
| NW | | | | | | | | |
| CALM | | | | | | | | |
| TOTAL % | | 5.3 | 46.6 | 46.6 | 5.3 | | 100.0 | 11.3 |

MEAN WIND SPEED: 23 KNOTS
DIRECTION: 120 DEG
DAY: 08
HOUR: 21

SEPTEMBER D A T A S U M M A R Y 46003
AVERAGE LATITUDE 52.0N AVERAGE LONGITUDE 168.0W

MEANS AND EXTREMES

| | MIN | (DA HR) | MEAN | MAX | (DA HR) | NO. OF OBS | DAYS WITH DATA |
|---|---|---|---|---|---|---|---|
| AIR TEMP (DEG C) | 10.1 | (01 21) | 11.1 | 12.8 | (05 00) | 46 | 7 |
| SEA TEMP (DEG C) | 10.0 | (02 21) | 11.1 | 11.9 | (07 00) | 46 | 7 |
| AIR-SEA TEMP (DEG C) | -02.0 | (06 12) | 00.0 | C1.0 | (05 00) | 46 | 7 |
| PRESSURE (MBAR) | 1002.7 | (01 00) | 1012.0 | 1025.0 | (06 06) | 46 | 7 |

# Selected Gale and Wave Observations, North Atlantic

## September and October 1978

| Vessel | Nationality | Date | Position of Ship | | Time GMT | Wind | | Visibility | Present Weather code | Pressure mb. | Temperature °C | | Sea Waves* | | Swell Waves | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lat. deg. | Long. deg. | | Dir. 10° | Speed kt. | n. mi. | | | Air | Sea | Period sec. | Height ft. | Dir. 10° | Period sec.* | Height ft. |
| NORTH ATLANTIC OCEAN | | SEP. | | | | | | | | | | | | | | | |
| PACET | BRITISH | 11 | 52.8 N | 49.9 W | 12 | 36 | 47 | 1 NM | | 991.7 | 9.0 | 5.0 | 6 | 13 | 01 | 6 | 19.5 |
| PACET | BRITISH | 12 | 51.4 N | 45.6 W | 06 | 32 | 47 | 2 NM | 02 | 1009.8 | 8.8 | 11.0 | 6 | 11.5 | | | |
| MANISTEE | BRITISH | 13 | 53.7 N | 43.8 W | 18 | 34 | 43 | 30 VD | 69 | 997.0 | 23.8 | | 4 | 8 | 01 | 7 | 14.5 |
| JEAN LYKES | AMERICAN | 19 | 40.4 N | 42.1 W | 03 | 34 | 48 | 2 NM | 80 | 993.6 | 20.5 | 22.3 | 6 | 13 | | | |
| RIGOLETTO | SWEDISH | 25 | 57.5 N | 19.5 W | 00 | 26 | 48 | 10 NM | 03 | 1003.0 | 10.0 | 14.0 | | | 26 | 9 | 29.5 |
| GREAT LAKES VESSELS | | | | | | | | | | | | | | | | | |
| HERBERT C JACKSON | AMERICAN | 3 | 42.2 N | 81.1 W | 12 | 21 | M 41 | 2 NM | 18 | | 21.0 | 23.0 | 3 | 8 | | | |
| EUGENE W PARGNY | AMERICAN | 12 | 47.6 N | 87.9 W | 00 | 06 | M 42 | 10 NM | 02 | | 11.0 | 14.0 | | 8 | | | |
| A H PERBERT | AMERICAN | 12 | 47.7 N | 90.5 W | 12 | 09 | M 43 | > 25 NM | 02 | | 11.0 | 12.0 | 6 | 13 | | | |
| HERBERT C JACKSON | AMERICAN | 13 | 42.4 N | 80.0 W | 12 | 07 | M 44 | 10 NM | 01 | | 14.0 | 21.0 | 6 | 10 | | | |
| CASON J CALLAWAY | AMERICAN | 18 | 45.6 N | 83.7 W | 18 | 09 | M 45 | 2 NM | 51 | | 9.0 | 10.0 | 9 | 16.5 | | | |
| HERBERT C JACKSON | AMERICAN | 18 | 45.8 N | 85.0 W | 18 | 08 | M 55 | 2 NM | 03 | | 11.0 | 10.0 | 3 | 6.5 | | | |
| NORTH ATLANTIC OCEAN | | OCT. | | | | | | | | | | | | | | | |
| OSCO SIERRA | NORWEGIAN | 6 | 43.1 N | 51.7 W | 12 | 25 | 50 | 10 NM | 02 | 1013.0 | 18.0 | 19.0 | | | 25 | X | 49 |
| AMER LEGACY | AMERICAN | 6 | 49.4 N | 29.9 W | 12 | 30 | 48 | 5 NM | 02 | 1000.4 | 13.6 | 13.0 | 5 | 6.5 | 31 | 11 | 23 |
| AMER LEGEND | AMERICAN | 6 | 42.8 N | 37.5 W | 00 | 32 | 50 | 10 NM | 02 | 1016.5 | 16.7 | 21.1 | 3 | 11.5 | 34 | 7 | 18 |
| AMER RANGER | AMERICAN | 6 | 52.6 N | 25.4 W | 18 | 36 | 45 | 1 NM | 51 | 988.8 | 17.0 | 12.4 | 6 | 13 | 35 | 10 | 16.5 |
| OSCO SIERRA | NORWEGIAN | 7 | 43.5 N | 29.7 W | 00 | 30 | 50 | 10 NM | 02 | 1014.0 | 14.0 | 18.1 | | | | | |
| AMER LEGEND | AMERICAN | 7 | 42.7 N | 27.7 W | 12 | 32 | 45 | 5 NM | 02 | 1004.0 | 16.7 | 17.7 | 5 | 13 | 33 | 8 | 23 |
| AMER RANGER | AMERICAN | 7 | 50.8 N | 26.3 W | 00 | 36 | 45 | 1 NM | 62 | 993.0 | 10.0 | 11.2 | 6 | 18 | | | |
| OSCO SIERRA | NORWEGIAN | 8 | 44.8 N | 24.0 W | 06 | 28 | 45 | 1 NM | 81 | 1012.0 | 13.0 | 18.0 | | | | | |
| DON JUAN | SWEDISH | 12 | 41.9 N | 39.4 W | 18 | 34 | 48 | 2 NM | 80 | 1002.5 | 16.5 | | 10 | 16.5 | | | |
| CONDAYA | HONDURAN | 12 | 39.7 N | 42.1 W | 12 | 30 | 52 | 10 NM | 16 | 1003.9 | 16.8 | 23.0 | 4 | 10 | 31 | 6 | 19.5 |
| STAGHOUND | AMERICAN | 12 | 39.6 N | 43.6 W | 12 | 33 | 54 | 10 NM | 02 | 1010.8 | 16.1 | 21.6 | 13 | 14.5 | 30 | >13 | 29.5 |
| JELA TOPIC | LIBERIAN | 12 | 38.3 N | 43.1 W | 12 | 27 | 50 | 5 NM | 02 | 1015.0 | 18.0 | 20.0 | 9 | 11.5 | | | |
| LASH PACIFICO | AMERICAN | 14 | 37.4 N | 58.4 W | 12 | 04 | M 43 | 10 NM | 01 | 1021.3 | 20.6 | 22.7 | 3 | 6.5 | | | |
| TEXACO MARYLAND | AMERICAN | 17 | 38.7 N | 74.9 W | 18 | 01 | 43 | 2 NM | 21 | 1022.7 | 14.4 | 17.8 | 6 | 16.5 | | | |
| POLYMYNNIA | NORWEGIAN | 17 | 49.7 N | 02.8 W | 18 | 33 | 50 | 5 NM | 02 | 1013.0 | 14.0 | 19.0 | | | | | |
| MARCONA CONVEYOR | LIBERIAN | 17 | 38.7 N | 74.7 W | 18 | 02 | M 42 | 1 NM | 69 | 1024.0 | 14.1 | 20.0 | 4 | 8 | 02 | 9 | 13 |
| KENSHO MARU | JAPANESE | 18 | 39.7 N | 57.7 W | 21 | 36 | M 48 | .25 NM | 65 | 999.6 | 13.5 | 24.0 | 6 | 19.5 | | | |
| POLYMYNNIA | NORWEGIAN | 18 | 50.2 N | 00.5 W | 00 | 33 | 50 | 5 NM | 02 | 1018.0 | 12.0 | 16.0 | | | | | |
| DEFIANCE | AMERICAN | 19 | 37.1 N | 56.1 W | 00 | 31 | 41 | 2 NM | 07 | 1002.5 | 19.5 | 22.8 | 3 | 13 | 28 | 8 | 16.5 |
| SEALAND VENTURE | AMERICAN | 19 | 39.3 N | 58.5 W | 06 | 34 | 41 | 5 NM | 02 | 1011.2 | 13.4 | 23.8 | 12 | 14.5 | | | |
| EXPORT PATRIOT | AMERICAN | 26 | 47.2 N | 36.6 W | 18 | 19 | 48 | 10 NM | 01 | 1001.8 | 17.2 | 17.8 | 3 | 8 | 16 | 7 | 11.5 |
| EXXON HOUSTON | AMERICAN | 30 | 32.8 N | 77.1 W | 15 | 03 | 43 | 5 NM | 01 | 1021.1 | 25.5 | 28.8 | 5 | 6.5 | 03 | 7 | 19.5 |
| TONCI TOPIC | LIBERIAN | 30 | 26.8 N | 72.8 W | 00 | 12 | 54 | 5 NM | 02 | 1014.0 | 24.0 | 27.0 | 6 | 6.5 | | | |
| AMER ARCHER | AMERICAN | 31 | 44.4 N | 41.9 W | 18 | 32 | 48 | 5 NM | 01 | 1015.6 | 8.9 | 10.6 | 9 | 16.5 | 33 | >13 | 24.5 |
| GREAT LAKES VESSELS | | | | | | | | | | | | | | | | | |
| LEON FRASER | AMERICAN | 6 | 45.2 N | 86.7 W | 06 | 32 | M 42 | 5 NM | 63 | | 7.0 | 13.0 | 6 | 10 | | | |
| SAMUEL MATHER | AMERICAN | 6 | 47.7 N | 85.2 W | 12 | 02 | M 43 | 10 NM | 60 | | 6.0 | 10.0 | 8 | 11.5 | | | |
| ROBERT C STANLEY | AMERICAN | 12 | 47.3 N | 86.5 W | 18 | 26 | M 44 | 10 NM | 29 | | 9.0 | | | 13 | | | |
| G M HUMPHREY | AMERICAN | 18 | 45.8 N | 85.1 W | 00 | 21 | M 42 | 10 NM | 09 | | 8.0 | 14.0 | 3 | 10 | | | |
| MESABI MINER | AMERICAN | 24 | 45.9 N | 85.5 W | 18 | 20 | M 46 | 10 NM | 02 | | 9.0 | 12.0 | 3 | 3 | | | |
| LEWISH | AMERICAN | 25 | 44.7 N | 86.7 W | 00 | 19 | M 43 | 10 NM | 02 | | 8.0 | 13.0 | 6 | 14.5 | | | |
| MIDDLETOWN | AMERICAN | 30 | 46.5 N | 87.2 W | 12 | 21 | M 42 | 10 NM | 02 | | 10.0 | 8.0 | 4 | 3 | | | |
| CHARLES M BEEGHLY | AMERICAN | 30 | 47.3 N | 87.2 W | 12 | 19 | M 44 | > 25 NM | 01 | | 5.0 | 8.0 | XX | 11.5 | | | |

\+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: The observations are selected from those with winds ≥ 35 kn or waves ≥ 25 ft from May through August (≥ 41 kn or ≥ 33 ft, September through April). In cases where a ship reported more than one observation a day with such values, the one with the highest windspeed was selected.

# Selected Gale and Wave Observations, North Pacific

## September and October 1978

| Vessel | Nationality | Date | Position of Ship | | Time GMT | Wind | | Visibility n. mi. | Present Weather code | Pressure mb. | Temperature °C | | Sea Waves† | | Swell Waves | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lat. deg. | Long. deg. | | Dir. 10° | Speed kt. | | | | Air | Sea | Period sec. | Height ft. | Dir. 10° | Period sec. | Height ft. |
| **NORTH PACIFIC OCEAN** | | SEP. | | | | | | | | | | | | | | | |
| ASIAN TRANSPORTER | LIBERIAN | 1 | 18.0 N | 108.2 W | 17 | 10 | N 30 | 2 | NN | 18 | 1009.2 | 28.2 | 24.5 | | | | |
| PRESIDENT MADISON | AMERICAN | 1 | 37.7 N | 149.8 E | 18 | 05 | N 45 | 10 | NN | 02 | 1003.0 | 21.1 | 26.1 | 3 | 13 | XX | X | 8 |
| ARIA HONESTY | LIBERIAN | 2 | 18.9 N | 109.1 W | 06 | 09 | N 34 | 4 | NN | 80 | 1008.5 | 28.0 | 30.0 | | | | | |
| OVERSEAS JUNEAU | AMERICAN | 2 | 22.2 N | 110.2 W | 18 | 12 | 45 | 5 | NN | 02 | 1007.5 | 29.5 | 25.5 | 3 | 8 | 18 | 7 | 46 |
| PRES PIERCE | AMERICAN | 2 | 50.8 N | 177.9 E | 06 | 20 | 30 | 5 | NN | 02 | 992.0 | 10.0 | 8.5 | 2 | 8 | 13 | 10 | 19.5 |
| VAN ENTERPRISE | LIBERIAN | 4 | 37.7 N | 148.6 E | 00 | 18 | N 45 | 1 | NN | | | | | | | 20 | 6 | 16.5 |
| PRES PIERCE | AMERICAN | 4 | 44.3 N | 156.0 E | 06 | 22 | 45 | 2 | NN | | 1002.0 | 24.0 | 22.5 | 5 | 11.5 | 20 | 6 | 19.5 |
| JAPAN RAINBOW | JAPANESE | 5 | 54.4 N | 168.6 W | 12 | 25 | N 45 | 1 | NN | 04 | 1002.0 | 14.0 | 17.3 | 2 | 8 | 20 | 6 | 13 |
| JAPAN RAINBOW | JAPANESE | 6 | 54.2 N | 172.6 W | 00 | 20 | N 45 | 1 | NN | 03 | 1012.0 | 9.0 | 10.0 | 3 | 5 | | | |
| ARCO ANCHORAGE | AMERICAN | 12 | 58.2 N | 149.8 W | 06 | 05 | N 60 | 9 | NN | 04 | 1011.0 | 9.0 | 9.0 | 3 | 6.5 | | | |
| | | | | | | | | 1 | NN | 69 | 992.0 | 12.3 | 11.2 | | | | | |
| ARCO PRUDHOE BAY | AMERICAN | 12 | 54.3 N | 137.9 W | 00 | 13 | N 45 | 9 | NN | 08 | 1006.0 | 14.4 | 13.8 | 2 | 8 | 13 | X | 6.5 |
| CHEVRON COLORADO | AMERICAN | 12 | 53.9 N | 145.4 W | 18 | 13 | N 42 | 5 | NN | 62 | 979.9 | 11.2 | | 4 | 11.5 | 16 | >13 | 26.5 |
| ZIM HONGKONG | ISRAEL | 12 | 28.9 N | 124.2 E | 18 | 07 | 35 | 9 | NN | 25 | 990.0 | 26.0 | | 7 | 23 | 07 | 7 | 26 |
| VAN ENTERPRISE | LIBERIAN | 12 | 50.8 N | 147.7 W | 06 | 22 | N 45 | 9 | NN | 02 | 984.5 | 12.0 | 10.5 | | | | | |
| VAN CONQUEROR | LIBERIAN | 12 | 50.4 N | 142.8 W | 06 | 21 | N 45 | 2 | NN | 02 | 993.0 | 13.0 | 13.0 | | | | | |
| MASSACHUSETTS | AMERICAN | 12 | 56.0 N | 141.0 W | 00 | 13 | 45 | 9 | NN | 07 | 998.3 | 13.8 | 13.3 | 4 | 14.5 | 13 | < 6 | 21 |
| ARCO FAIRBANKS | AMERICAN | 13 | 60.0 N | 146.0 W | 00 | 10 | N 30 | 9 | NN | 02 | 991.9 | 12.2 | 10.0 | 7 | 14.5 | | | |
| ARCO ANCHORAGE | AMERICAN | 13 | 58.6 N | 140.8 W | 06 | 35 | N 35 | 9 | NN | 01 | 1003.8 | 12.3 | 10.0 | | | | | |
| PORTLAND | AMERICAN | 13 | 59.3 N | 144.8 W | 18 | 14 | 42 | 2 | NN | 65 | 990.9 | 10.0 | 13.9 | 4 | 13 | 18 | 9 | 13 |
| ILLINOIS | AMERICAN | 14 | 51.9 N | 124.9 E | 12 | 35 | 48 | 9 | NN | 02 | 999.1 | 24.1 | 25.6 | 6 | 8 | 04 | 8 | 11.5 |
| MOBIL MERIDIAN | AMERICAN | 14 | 57.9 N | 142.5 W | 06 | 13 | N 34 | 9 | NN | 02 | 981.0 | 11.1 | 11.7 | 6 | 11.5 | 13 | 10 | 37.8 |
| VAN CONQUEROR | LIBERIAN | 14 | 50.5 N | 151.3 W | 00 | 27 | N 42 | 9 | NN | 03 | 995.0 | 12.0 | 12.0 | | | | | |
| WESTWARD VENTURE | AMERICAN | 14 | 56.7 N | 142.7 W | 03 | 13 | N 45 | .9 | NN | 65 | 980.9 | 12.2 | 12.0 | | | | | |
| ARCO ANCHORAGE | AMERICAN | 14 | 52.1 N | 136.8 W | 00 | 16 | N 45 | 2 | NN | 63 | 1003.0 | 12.7 | 11.2 | 5 | 21 | 13 | 10 | 11.5 |
| ARCO FAIRBANKS | AMERICAN | 14 | 58.8 N | 140.8 W | 06 | 16 | N 45 | 2 | NN | 80 | 998.6 | 14.4 | 10.6 | 7 | 11.5 | | | |
| CORNUCOPIA | AMERICAN | 14 | 58.6 N | 148.0 W | 00 | 13 | N 45 | 2 | NN | 21 | 979.8 | 10.6 | 12.2 | | | 13 | >13 | 16.5 |
| CHEVRON COLORADO | AMERICAN | 14 | 52.5 N | 138.8 W | 00 | 10 | N 32 | 2 | NN | 02 | 997.2 | 11.7 | | 4 | 14.5 | 19 | 11 | 11.5 |
| PORTLAND | AMERICAN | 14 | 54.7 N | 142.6 W | 00 | 14 | 50 | .9 | NN | 03 | 984.8 | 11.7 | 12.2 | 7 | 16.5 | 17 | 9 | 19.5 |
| PRESIDENT MADISON | AMERICAN | 14 | 34.0 N | 139.1 W | 12 | 28 | N 45 | 10 | NN | 02 | 998.6 | 11.1 | 10.6 | 11 | 26.5 | | | |
| CUMBERLANDIA | SINGAPORE | 15 | 33.8 N | 174.7 W | 00 | 04 | N 44 | .9 | NN | 61 | 1017.0 | 19.5 | 24.0 | 8 | 23 | | | |
| SURYALUS | LIBERIAN | 15 | 48.8 N | 146.6 E | 00 | 23 | 41 | 9 | NN | 02 | 1001.0 | 2.0 | 3.0 | 6 | 19.5 | | | |
| MOBIL MERIDIAN | AMERICAN | 15 | 53.6 N | 139.8 W | 06 | 23 | N 34 | 9 | NN | 03 | 1000.0 | 11.2 | 12.3 | 6 | 8 | 21 | 11 | 34.5 |
| SINCERE 3 | LIBERIAN | 15 | 34.2 N | 142.8 W | 06 | 28 | N 42 | 10 | NN | 02 | 1010.0 | 9.0 | 10.0 | | | | | |
| SVER SUMMIT | PANAMANIAN | 16 | 41.9 N | 143.4 E | 18 | 02 | N 47 | .9 | NN | 33 | 995.5 | 10.5 | | | | | | |
| IRIS ISLAND | JAPANESE | 17 | 42.2 N | 142.2 E | 18 | 18 | N 42 | 200 | YD | 58 | 999.9 | 17.0 | 10.0 | | | | | |
| PORTLAND | AMERICAN | 18 | 50.2 N | 129.3 W | 00 | 34 | 42 | 10 | NN | 02 | 1021.3 | 12.2 | 10.1 | 6 | 13 | 31 | 7 | 13 |
| OJI GLORIA | LIBERIAN | 18 | 41.8 N | 180.5 E | 06 | 33 | N 44 | .9 | NN | 03 | 998.0 | 13.0 | 14.0 | 5 | 6.5 | 33 | 6 | 10 |
| PRESIDENT MADISON | AMERICAN | 18 | 48.8 N | 153.2 E | 00 | 05 | N 30 | 200 | YD | 49 | 993.0 | 11.7 | 11.1 | 9 | 18 | 09 | 12 | 29.5 |
| LING YUNG | CHINESE | 21 | 36.1 N | 101.6 W | 00 | 28 | 43 | 5 | NN | 02 | 1013.3 | 9.0 | 10.0 | 10 | 29.5 | 28 | 12 | 32.5 |
| ROSE CITY | AMERICAN | 26 | 44.2 N | 140.7 W | 18 | 26 | 45 | 2 | NN | 02 | 995.1 | 12.8 | 10.0 | 8 | 16.5 | | | |
| ROSE CITY | AMERICAN | 27 | 44.3 N | 138.7 W | 00 | 24 | 30 | 2 | NN | 30 | 994.4 | 13.4 | 10.0 | 8 | 16.5 | 26 | 9 | 19.5 |
| OVERSEAS JUNEAU | AMERICAN | 27 | 49.9 N | 133.0 W | 00 | 18 | 30 | 1 | NN | 63 | 991.2 | 12.8 | 11.7 | 7 | 19.5 | | | |
| ARCO PRUDHOE BAY | AMERICAN | 27 | 52.2 N | 136.9 W | 00 | 11 | N 30 | 9 | NN | 02 | 990.0 | 14.0 | 12.3 | 3 | 6.5 | | | |
| NORTH PACIFIC OCEAN | | SEP. | | | | | | | | | | | | | | | | |
| ENVIRONMENTAL BUOYS | | | | | | | | | | | | | | | | | | |
| 46005 | AMERICAN | 26 | 46.0 N | 131.0 W | 14 | 17 | N 42 | | | | 993.4 | 15.3 | 15.6 | | | | | |
| **NORTH PACIFIC OCEAN** | | OCT. | | | | | | | | | | | | | | | | |
| AVESTA | SWEDISH | 1 | 38.8 N | 184.8 W | 12 | 17 | N 44 | 9 | NN | 17 | 1007.8 | 21.0 | 21.0 | | | | | |
| S P LEE | AMERICAN | 2 | 39.3 N | 183.8 W | 18 | 25 | 51 | 9 | NN | 03 | 999.8 | 17.8 | 18.9 | 5 | 19.5 | | | |
| AVESTA | SWEDISH | 2 | 36.5 N | 184.2 W | 12 | 20 | N 44 | 9 | NN | 02 | 1008.0 | 21.6 | 21.0 | | | | | |
| S P LEE | AMERICAN | 3 | 39.2 N | 186.2 W | 00 | 27 | 30 | 9 | NN | 02 | 1002.0 | 17.8 | 23.9 | 5 | 24.5 | 26 | 11 | 41 |
| AVESTA | SWEDISH | 3 | 36.1 N | 187.7 W | 00 | 29 | N 46 | 9 | NN | 02 | 1008.9 | 20.2 | 21.0 | 12 | 16.5 | | | |
| HONSHU GLORIA | LIBERIAN | 3 | 48.3 N | 181.9 W | 00 | 09 | N 41 | 9 | NN | 63 | 1001.0 | 11.2 | | 3 | 5 | | | |
| BLUE OCEAN | JAPANESE | 4 | 50.0 N | 180.9 W | 00 | 16 | N 45 | .25 | NN | 54 | 996.0 | 11.5 | 10.0 | 8 | 26 | | | |
| HONSHU GLORIA | LIBERIAN | 4 | 48.2 N | 181.4 W | 06 | 23 | N 46 | 9 | NN | 09 | 998.2 | 11.5 | 11.1 | 7 | 6.5 | 14 | 8 | 6.5 |
| MOBIL MERIDIAN | AMERICAN | 4 | 53.7 N | 195.8 W | 18 | 14 | N 30 | 10 | NN | 21 | 1016.0 | 12.2 | 12.2 | | | 18 | X | 32.5 |
| ALASKA STANDARD | AMERICAN | 5 | 59.8 N | 152.0 W | 00 | 03 | 45 | 10 | NN | 03 | 996.8 | 8.5 | 14.5 | 6 | 16.5 | | | |
| MOBIL MERIDIAN | AMERICAN | 5 | 51.9 N | 193.1 W | 03 | 14 | N 48 | 1 | NN | 35 | 1020.0 | 13.3 | 12.2 | | | | | |
| SEATRAIN PRINCETON | GERMAN | 6 | 41.3 N | 181.5 W | 18 | 26 | 44 | 2 | NN | 20 | 991.2 | 17.2 | 16.0 | 9 | 11.5 | | | |
| PRES JEFFERSON | AMERICAN | 7 | 48.8 N | 186.0 E | 18 | 10 | 60 | 5 | NN | 82 | 984.1 | 8.7 | 7.7 | 5 | 11.5 | 26 | 6 | 16.5 |
| VAN WARRIOR | LIBERIAN | 7 | 46.8 N | 181.0 E | 12 | 29 | 30 | 10 | NN | 60 | 1004.5 | 13.0 | 13.0 | | | | | |
| PACIFIC WING | PANAMANIAN | 7 | 49.9 N | 183.0 E | 18 | 28 | N 44 | 200 | YD | 63 | 985.8 | 7.9 | 9.9 | 7 | 23 | XX | X | 19.5 |
| BLUEBIRD | JAPANESE | 7 | 48.9 N | 139.8 W | 18 | 18 | N 43 | .25 | NN | 69 | 986.5 | 13.0 | 13.0 | 5 | 6.5 | 19 | 10 | 16.5 |
| VAN WARRIOR | LIBERIAN | 8 | 44.1 N | 189.4 E | 00 | 29 | 30 | 10 | NN | 02 | 1012.0 | 12.0 | 17.0 | | | | | |
| PRES JEFFERSON | AMERICAN | 8 | 47.1 N | 185.6 E | 06 | 27 | 45 | 5 | NN | 80 | 994.2 | 9.4 | 9.4 | 6 | 14.5 | 27 | 8 | 28 |
| PACIFIC WING | PANAMANIAN | 8 | 49.2 N | 180.5 E | 00 | 30 | N 43 | 1 | NN | 80 | 992.7 | 7.8 | 9.0 | 6 | 26.5 | XX | X | 19.5 |
| PRINCE WILLIAM SOUND | AMERICAN | 8 | 51.9 N | 188.5 W | 00 | 15 | N 41 | 5 | NN | 80 | 995.3 | 14.4 | 12.8 | 4 | 10 | 15 | 6 | 16.5 |
| ARCO PRUDHOE BAY | AMERICAN | 8 | 60.0 N | 148.0 W | 18 | 12 | N 45 | 2 | NN | 21 | 976.8 | 11.2 | 10.6 | | | 12 | 10 | 24.5 |
| GLACIER BAY | AMERICAN | 8 | 52.7 N | 137.2 W | 00 | 15 | 50 | 2 | NN | 02 | 986.5 | 12.2 | 10.0 | | | 16 | 8 | 32.5 |
| HAN WOO | KOREAN | 8 | 51.9 N | 144.2 W | 00 | 27 | N 42 | .9 | NN | 08 | 970.5 | 13.2 | 13.0 | 10 | 13 | | | |
| ARCO JUNEAU | AMERICAN | 9 | 59.0 N | 144.0 W | 18 | 11 | N 44 | 5 | NN | 62 | 981.4 | 7.8 | 8.7 | 2 | 5 | 18 | < 6 | 6.5 |
| ARCO PRUDHOE BAY | AMERICAN | 9 | 59.9 N | 148.9 W | 00 | 12 | N 70 | 1 | NN | 07 | 976.0 | 11.2 | 10.6 | | | 12 | 10 | 24.5 |
| EXXON PHILADELPHIA | AMERICAN | 9 | 58.4 N | 148.9 W | 18 | 14 | 45 | 5 | NN | 18 | 977.0 | 9.5 | 11.7 | 4 | 8 | 18 | < 6 | 26.5 |
| PRINCE WILLIAM SOUND | AMERICAN | 9 | 57.2 N | 149.5 W | 00 | 20 | N 41 | 5 | NN | 62 | 990.5 | 10.6 | 11.7 | 7 | 23 | | | |
| SANTA CLARA | AMERICAN | 9 | 54.7 N | 142.2 W | 12 | 19 | 45 | 5 | NN | 62 | 990.2 | 8.9 | 11.0 | XX | 6.5 | 21 | 11 | 10 |
| VAN WARRIOR | LIBERIAN | 10 | 37.8 N | 148.0 E | 12 | 34 | 45 | 1 | NN | 10 | 1009.0 | 20.0 | 21.0 | | | | | |
| PRES HARRISON | AMERICAN | 11 | 24.6 N | 180.5 E | 06 | 04 | 47 | 2 | NN | 02 | 1004.0 | 23.0 | 23.0 | | | | | |
| PRES HARRISON | AMERICAN | 12 | 23.7 N | 121.7 E | 06 | 02 | 50 | 2 | NN | 02 | 1007.0 | 22.8 | 24.5 | | 8 | 04 | 6 | 16.5 |
| GOLDEN GATE BRIDGE | JAPANESE | 13 | 49.3 N | 151.4 W | 18 | 03 | N 43 | 2 | NN | 69 | 1009.0 | 10.0 | 13.0 | 8 | 8 | 03 | 7 | 19.5 |
| MOBIL MERIDIAN | AMERICAN | 13 | 58.2 N | 149.8 W | 18 | 29 | N 45 | 7 | NN | | | | | | | 20 | < 6 | 10 |
| JARVIS | AMERICAN | 13 | 56.9 N | 150.5 W | 11 | 29 | N 50 | 1 | NN | | 996.0 | 8.3 | 10.0 | | | 18 | X | 26 |
| PRES HARRISON | AMERICAN | 13 | 26.6 N | 122.5 E | 12 | 04 | 50 | .9 | NN | 07 | 997.6 | 8.6 | 9.1 | 9 | 8 | | | |
| MOBIL MERIDIAN | AMERICAN | 14 | 55.1 N | 138.0 W | 18 | 13 | N 45 | 9 | NN | 21 | 1007.2 | 21.1 | 23.9 | 7 | 11.5 | | | |
| GOLDENROD | LIBERIAN | 14 | 40.9 N | 169.2 E | 06 | 28 | N 45 | 200 | YD | 02 | 1013.0 | 11.1 | 10.0 | | | | | |
| JAPAN RAINBOW | JAPANESE | 15 | 37.4 N | 167.4 E | 12 | 28 | N 45 | 200 | YD | 07 | 988.4 | 13.0 | 17.0 | 5 | 13 | 28 | >13 | 40 |
| ATLANTIC PIONEER | PANAMANIAN | 15 | 38.6 N | 172.4 E | 12 | 28 | N 45 | 2 | NN | 30 | 1004.0 | 13.0 | 23.0 | 6 | 8 | | | |
| UNIVERSE KURE | LIBERIAN | 15 | 44.3 N | 162.2 W | 06 | 18 | N 42 | 1 | NN | | 995.2 | 14.5 | 20.0 | | 14.5 | 27 | 6 | 19.5 |
| JAPAN RAINBOW | JAPANESE | 16 | 36.7 N | 172.5 E | 06 | 34 | N 41 | 1 | NN | 63 | 998.3 | 14.0 | 13.4 | 8 | 13 | | | |
| ORIENTAL SOVEREIGN | LIBERIAN | 16 | 34.1 N | 195.3 W | 00 | 13 | N 45 | 10 | NN | 03 | 1011.0 | 18.0 | 20.0 | 7 | 10 | | | |
| GOLDENROD | LIBERIAN | 16 | 40.9 N | 172.2 E | 06 | 31 | N 50 | .9 | NN | 62 | 999.7 | 8.0 | 10.0 | 5 | 26 | 16 | < 6 | 32.5 |
| HONSHU GLORIA | LIBERIAN | 16 | 53.6 N | 180.4 W | 00 | 14 | N 48 | 2 | NN | 07 | 998.5 | 13.0 | 17.0 | 6 | 14.5 | 31 | 11 | 30.5 |
| | | | | | | | | 2 | NN | 10 | 994.6 | 9.0 | 14.0 | 5 | 6.5 | | | |

| Vessel | Nationality | Date | Position of Ship | | Time GMT | Wind | | Visibility n. mi. | Present Weather code | Pressure mb. | Temperature °C | | Sea Waves+ | | Swell Waves | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lat. deg. | Long. deg. | | Dir. 10° | Speed kt. | | | | Air | Sea | Period sec. | Height ft. | Dir. 10° | Period sec. | Height ft. |
| NORTH PACIFIC OCEAN | | OCT. | | | | | | | | | | | | | | | |
| ATLANTIC PIONEER | PANAMANIAN | 16 | 38.4 N | 171.7 E | 00 | 31 | M 42 | 5 NM | 02 | 1005.5 | 15.0 | 20.0 | XX | 14.9 | 32 | 6 | 19.5 |
| ASIA BRAVERY | LIBERIAN | 16 | 14.1 N | 94.8 W | 00 | 02 | M 42 | 2 NM | 02 | 1009.0 | 27.0 | 30.0 | 6 | 18 | 03 | 10 | 19.5 |
| PACIFIC ACE | PANAMANIAN | 16 | 39.2 N | 178.4 W | 00 | 26 | M 35 | 2 NM | 02 | 991.5 | 16.0 | 20.0 | 5 | 19.5 | 26 | 7 | 39 |
| PACIFIC VENTURE | PANAMANIAN | 16 | 37.9 N | 179.3 W | 00 | 27 | M 30 | 2 NM | 07 | 996.2 | 19.0 | 21.5 | 4 | 16 | | | |
| MEDITERRANEAN CARRIER | BRITISH | 17 | 38.5 N | 168.8 W | 00 | 28 | 48 | 10 NM | 18 | 1008.3 | 18.5 | 17.0 | 6 | 10 | 28 | 6 | 29.5 |
| GREAT OCEAN | JAPANESE | 17 | 39.1 N | 154.4 E | 17 | 25 | M 32 | 2 NM | 18 | 996.5 | 16.0 | 20.0 | 10 | 21 | XX | X | 24.5 |
| HONSHU GLORIA | LIBERIAN | 17 | 54.1 N | 171.3 W | 18 | 33 | M 46 | 10 NM | 02 | 992.5 | 8.0 | 7.5 | 7 | 24.5 | | | |
| FRIENDSHIP | LIBERIAN | 17 | 41.8 N | 165.9 E | 18 | 07 | M 44 | 1 NM | | 997.0 | 12.0 | 18.0 | 6 | 14.5 | | | |
| WASHINGTON RAINBOW | JAPANESE | 17 | 52.0 N | 154.3 W | 12 | 24 | M 45 | 1 NM | 40 | 984.0 | 10.0 | 9.0 | 3 | 10 | | | |
| PRESIDENT MADISON | AMERICAN | 17 | 39.4 N | 144.6 E | 00 | 31 | M 45 | 10 NM | 18 | 1012.0 | 12.2 | 15.6 | 8 | 10 | 31 | 11 | 16.5 |
| HONSHU GLORIA | LIBERIAN | 18 | 33.6 N | 175.2 W | 06 | 34 | M 42 | 10 NM | 09 | 1007.2 | 6.0 | 8.0 | | | | | |
| FRIENDSHIP | LIBERIAN | 18 | 42.3 N | 167.2 E | 06 | 04 | M 45 | 1 NM | | 994.5 | 10.0 | 14.5 | 12 | 23 | 04 | >13 | 29.5 |
| PACIFIC WING | PANAMANIAN | 18 | 36.2 N | 179.3 W | 06 | 16 | M 43 | 1 NM | 07 | 1005.9 | 19.5 | 21.0 | 6 | 21 | | | |
| MEDITERRANEAN CARRIER | BRITISH | 19 | 37.5 N | 178.0 E | 18 | 29 | 48 | 10 NM | 02 | 1014.5 | 18.0 | 18.0 | 5 | 24.5 | 30 | 11 | 36 |
| FRIENDSHIP | LIBERIAN | 19 | 42.5 N | 170.8 E | 00 | 36 | M 41 | 2 NM | 02 | 1001.0 | 11.0 | 14.0 | 12 | 23 | 01 | >13 | 28 |
| MEDITERRANEAN CARRIER | BRITISH | 20 | 37.2 N | 178.6 E | 00 | 27 | 45 | 10 NM | 18 | 1018.5 | 19.0 | 18.0 | 5 | 24.5 | 30 | 9 | 36 |
| GLADIOLUS | LIBERIAN | 21 | 42.4 N | 154.8 E | 12 | 30 | M 45 | 1 NM | 10 | 1004.0 | 13.0 | 14.0 | 3 | 6.5 | 13 | 7 | 10 |
| WASHINGTON RAINBOW | JAPANESE | 22 | 48.9 N | 170.3 E | 06 | 20 | M 45 | 1 NM | 07 | 998.5 | 14.0 | 10.0 | 5 | 10 | 18 | 6 | 13 |
| MEDITERRANEAN CARRIER | BRITISH | 22 | 36.7 N | 165.5 E | 18 | 27 | 50 | 10 NM | 01 | 1008.5 | 19.5 | 17.0 | 5 | 10 | 27 | 8 | 19.5 |
| GOLDEN DAISY | LIBERIAN | 22 | 49.6 N | 178.2 W | 21 | 19 | M 38 | 1 NM | 69 | 989.0 | 10.5 | 8.0 | 6 | 16.5 | 20 | 8 | 23 |
| SAMUEL S | LIBERIAN | 23 | 53.5 N | 177.2 E | 12 | 31 | M 44 | 1 NM | | 985.0 | 6.0 | 6.0 | 5 | 5 | 30 | 11 | 13 |
| ZORELLA LYKES | AMERICAN | 23 | 30.7 N | 153.8 W | 18 | 02 | M 42 | 10 NM | 02 | 1017.5 | 18.9 | 23.9 | 8 | 18 | 01 | 12 | 18 |
| MAMMOTH PIR | LIBERIAN | 23 | 46.5 N | 144.6 W | 18 | 21 | M 45 | 5 NM | 81 | 1003.5 | 12.4 | 12.0 | 12 | 32.5 | 24 | 10 | 16.5 |
| GOLDEN DAISY | LIBERIAN | 23 | 49.5 N | 176.3 W | 00 | 19 | M 47 | 1 NM | 69 | 983.0 | 10.5 | 8.0 | 6 | 16.5 | 20 | 8 | 23 |
| BLUEBIRD | JAPANESE | 23 | 49.7 N | 166.5 W | 12 | 21 | M 44 | 1 NM | | 986.0 | 10.5 | 11.5 | 8 | 19.5 | | | |
| MEDITERRANEAN CARRIER | BRITISH | 23 | 37.3 N | 165.7 E | 00 | 28 | 41 | 10 NM | 18 | 1014.5 | 20.0 | | 5 | 13 | XX | X | 19.5 |
| PHILADELPHIA | AMERICAN | 23 | 34.3 N | 164.1 W | 12 | 18 | 45 | 2 NM | 64 | 978.0 | 7.8 | 8.9 | 4 | 16.5 | 18 | < 6 | 24.5 |
| NORTH STAR III | AMERICAN | 23 | 55.4 N | 160.4 W | 12 | 17 | M 35 | 1 NM | 69 | 971.9 | 7.2 | 7.2 | | | | | |
| ALEUTIAN DEVELOPER | AMERICAN | 23 | 56.1 N | 156.0 W | 12 | 23 | 45 | 5 NM | 38 | 963.0 | 8.8 | 7.7 | 6 | 10 | | | |
| JARVIS | AMERICAN | 23 | 54.9 N | 160.9 W | 21 | 26 | M 49 | 2 NM | 02 | 970.5 | 6.3 | 6.1 | 8 | 10 | | | |
| PHILADELPHIA | AMERICAN | 24 | 54.1 N | 169.1 W | 06 | 24 | 43 | 2 NM | 63 | 977.3 | 9.4 | 6.2 | 6 | 16.5 | 23 | 6 | 26 |
| NORTH STAR III | AMERICAN | 24 | 53.1 N | 164.4 W | 18 | 25 | M 35 | 10 NM | 02 | 990.2 | 6.1 | 8.3 | 10 | 24.5 | | | |
| JARVIS | AMERICAN | 24 | 56.5 N | 160.8 W | 03 | 20 | M 43 | 5 NM | 01 | 979.2 | 5.8 | 8.9 | 8 | 11.5 | | | |
| ALEUTIAN DEVELOPER | AMERICAN | 24 | 56.9 N | 154.4 W | 00 | 18 | 60 | 1 NM | | 984.1 | 7.2 | 7.2 | 7 | 14.5 | | | |
| ZORELLA LYKES | AMERICAN | 24 | 29.4 N | 153.0 W | 00 | 01 | M 42 | 5 NM | 02 | 1012.5 | 18.9 | 23.9 | 9 | 23 | | | |
| SAMUEL S | LIBERIAN | 24 | 53.2 N | 174.5 E | 00 | 31 | M 51 | 2 NM | 01 | 1000.0 | 10.0 | 6.0 | 5 | 5 | 30 | 11 | 14.5 |
| SPRUCE | JAPANESE | 24 | 53.5 N | 178.5 W | 12 | 32 | M 43 | 1 NM | | 1002.0 | 4.0 | 7.0 | 10 | 16.5 | 12 | >13 | 24.5 |
| WECOMA | AMERICAN | 24 | 53.9 N | 148.9 W | 06 | 19 | M 42 | 2 NM | | 1000.0 | 8.3 | 7.2 | 8 | 14.5 | 24 | 9 | 18 |
| PHILADELPHIA | AMERICAN | 25 | 53.7 N | 171.6 W | 00 | 29 | 50 | 5 NM | 02 | 998.6 | 5.6 | 6.7 | 5 | 16.5 | 27 | 7 | 29.5 |
| NORTH STAR III | AMERICAN | 25 | 52.6 N | 164.7 W | 00 | 26 | M 45 | 10 NM | 18 | 997.3 | 5.0 | 2.8 | 12 | 29.5 | | | |
| JARVIS | AMERICAN | 25 | 52.6 N | 160.7 W | 00 | 28 | M 46 | 5 NM | 02 | 997.7 | 5.4 | 7.2 | 10 | 19.5 | | | |
| ALEUTIAN DEVELOPER | AMERICAN | 26 | 56.3 N | 153.3 W | 00 | 25 | 45 | 10 NM | 02 | 994.2 | 8.9 | 6.2 | 7 | 11.5 | | | |
| SAMUEL S | LIBERIAN | 27 | 47.1 N | 158.4 E | 00 | 27 | M 50 | 5 NM | 01 | 1009.0 | 10.0 | 6.0 | 5 | 5 | 28 | 10 | 13 |
| SPRUCE | JAPANESE | 27 | 47.3 N | 162.1 E | 06 | 27 | M 50 | 5 NM | 01 | 1007.0 | 6.5 | 5.5 | 10 | 16.5 | 09 | 9 | 16.5 |
| PRES JOHNSON | AMERICAN | 27 | 26.5 N | 124.0 E | 18 | 02 | 50 | 5 NM | 07 | 1019.5 | 21.6 | 25.0 | 7 | 11.5 | | | |
| JARVIS | AMERICAN | 27 | 52.5 N | 176.7 E | 21 | 23 | M 36 | 1 NM | 53 | 986.0 | 5.4 | 7.0 | 8 | 16.5 | | | |
| VAN ENTERPRISE | LIBERIAN | 28 | 43.7 N | 177.4 E | 18 | 20 | M 30 | .5 NM | 51 | 1003.5 | 15.0 | 9.0 | | | | | |
| TOWNSEND CROMWELL | AMERICAN | 28 | 25.6 N | 170.7 W | 18 | 07 | M 47 | 1 NM | | 1019.0 | 22.3 | 25.1 | 7 | 5 | | | |
| ROSE | LIBERIAN | 28 | 31.9 N | 156.2 W | 12 | 04 | M 48 | 2 NM | 02 | 1017.4 | 20.0 | 23.0 | | | | | |
| PRES PIERCE | AMERICAN | 28 | 53.5 N | 177.0 W | 06 | 23 | 56 | 5 NM | 02 | 990.4 | 7.2 | 7.8 | 14 | 29.5 | | | |
| JARVIS | AMERICAN | 28 | 52.4 N | 176.5 E | 00 | 25 | M 36 | 2 NM | 07 | 995.1 | 7.5 | 7.2 | 9 | 19.5 | | | |
| VAN ENTERPRISE | LIBERIAN | 29 | 46.9 N | 179.0 E | 00 | 27 | 45 | .25 NM | 63 | 1005.0 | 13.0 | 7.5 | 5 | 19.5 | 23 | 6 | 24.5 |
| WECOMA | AMERICAN | 29 | 57.6 N | 131.9 W | 12 | 16 | M 45 | 1 NM | 63 | 990.1 | 7.2 | 7.8 | 2 | 6.5 | 16 | 8 | 10 |
| VIOLET | LIBERIAN | 29 | 39.7 N | 179.1 W | 06 | 22 | M 30 | 5 NM | 02 | 1025.5 | 17.0 | 15.0 | 2 | 8 | 18 | < 6 | 16.5 |
| TONAMI MARU | JAPANESE | 29 | 51.4 N | 165.0 W | 06 | 22 | 46 | .5 NM | 62 | 991.5 | 9.7 | 9.0 | 10 | 14.5 | 23 | 12 | 19.5 |
| PACIFIC WING | PANAMANIAN | 29 | 54.0 N | 159.7 W | 12 | 25 | M 45 | 1 NM | 80 | 987.5 | 6.5 | 7.0 | XX | 19.5 | XX | X | 21 |
| GOLDEN DAISY | LIBERIAN | 29 | 41.8 N | 143.0 E | 12 | 09 | M 34 | 2 NM | 69 | 1003.0 | 7.0 | 9.0 | | | | | |
| ALEUTIAN DEVELOPER | AMERICAN | 29 | 54.3 N | 164.8 W | 00 | 19 | M 43 | 5 NM | 51 | 996.3 | 4.5 | 8.3 | 4 | 8 | 19 | 7 | 11.5 |
| PACIFIC VENTURE | PANAMANIAN | 29 | 53.9 N | 148.2 W | 18 | 23 | M 35 | 1 NM | 81 | 1005.0 | 9.0 | 7.5 | | | 23 | >13 | 36.5 |
| SOUTHWELL | AMERICAN | 29 | 55.4 N | 164.6 W | 18 | 26 | M 43 | 2 NM | 27 | 980.1 | 2.9 | 7.2 | | 19.5 | | | |
| JARVIS | AMERICAN | 29 | 52.9 N | 169.5 E | 03 | 28 | M 30 | 1 NM | 88 | 989.9 | 2.0 | 7.2 | 7 | 8 | | | |
| TONAMI MARU | JAPANESE | 30 | 52.1 N | 159.0 W | 00 | 25 | 41 | 1 NM | 21 | 992.0 | 6.8 | 8.5 | 10 | 16.5 | 22 | >13 | 23 |
| PACIFIC VENTURE | PANAMANIAN | 30 | 53.9 N | 153.5 W | 06 | 23 | M 49 | 1 NM | | 1001.0 | 8.0 | 7.0 | | | 23 | >13 | 29.5 |
| PHILADELPHIA | AMERICAN | 30 | 40.5 N | 149.2 E | 06 | 32 | 50 | 5 NM | 02 | 1015.9 | 12.2 | 10.7 | 5 | 19.5 | 32 | < 6 | 29.5 |
| PORTLAND | AMERICAN | 30 | 53.1 N | 134.8 W | 18 | 20 | 45 | 5 NM | 03 | 1013.9 | 13.2 | 11.1 | 4 | 6.5 | 25 | 7 | 18 |
| ALEUTIAN DEVELOPER | AMERICAN | 30 | 53.3 N | 169.2 W | 00 | 23 | M 45 | 5 NM | 79 | 980.7 | 2.2 | 6.2 | 7 | 10 | 23 | 9 | 16.5 |
| SOUTHWELL | AMERICAN | 30 | 55.6 N | 165.9 W | 06 | 22 | M 46 | 2 NM | 07 | 968.2 | 4.0 | 7.8 | | | | | |
| ALASKA STANDARD | AMERICAN | 30 | 57.8 N | 150.2 W | 12 | 23 | 49 | 10 NM | 29 | 979.5 | 5.5 | 11.7 | 5 | 16.5 | | | |
| PACIFIC VENTURE | PANAMANIAN | 31 | 54.1 N | 156.8 W | 00 | 24 | M 45 | 5 NM | 02 | 980.0 | 9.0 | 9.5 | | | 26 | >13 | 39.5 |
| PORTLAND | AMERICAN | 31 | 54.0 N | 134.4 W | 00 | 20 | 52 | 1 NM | 63 | 998.3 | 9.4 | 8.3 | 7 | 16.5 | 24 | 8 | 23 |
| NORTH PACIFIC OCEAN | | OCT | | | | | | | | | | | | | | | |
| ENVIRONMENTAL BUOYS | | | | | | | | | | | | | | | | | |
| 46001 | AMERICAN | 8 | 56.0 N | 148.0 W | 15 | 27 | M 42 | | | 975.7 | 7.7 | 11.3 | | | | | |
| 46004 | AMERICAN | 7 | 51.0 N | 136.0 W | 21 | 15 | M 43 | | | 996.6 | 13.2 | 13.0 | 7 | 13 | | | |
| 46004 | AMERICAN | 31 | 51.0 N | 136.0 W | 00 | 19 | M 44 | | | 1009.4 | 12.0 | 11.6 | 9 | 19.5 | | | |

\+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: The observations are selected from those with winds ≥ 35 kn or waves ≥ 25 ft from May through August (≥ 41 kn or ≥ 33 ft, September through April). In cases where a ship reported more than one observation a day with such values, the one with the highest windspeed was selected.

# U.S. Cooperative Ship Weather Reports

## September and October 1978

| SHIP NAME | VIA RADIO | VIA MAIL |
|---|---|---|
| ACONCAGUA | | |
| ADRIAN MAERSK | 12 | 9 |
| AFRICAN METEOR | 41 | 68 |
| AIMEE LYKES | 2 | 3 |
| ALBERT MAERSK | 3 | 84 |
| ALISA | 26 | 90 |
| ALVA MAERSK | 4 | |
| AMERICAN ACCORD | 42 | 149 |
| AMERICAN AQUARIUS | 29 | 92 |
| AMERICAN ASTRONAUT | 27 | 99 |
| AMERICAN CHIEFTAIN | 36 | 44 |
| AMERICAN LANCER | 17 | 70 |
| AMERICAN LEGEND | 23 | 83 |
| AMERICAN RACER | 26 | 120 |
| AMOCO VIRGINIA | 9 | 40 |
| ANDERS MAERSK | 1 | |
| ANTONIA JOHNSON | 27 | 70 |
| ARCO FAIRBANKS | 6 | 24 |
| ARCO PRUDHOE BAY | 19 | 66 |
| ARILD MAERSK | 69 | 104 |
| ARTHUR MIDDLETON | 99 | 128 |
| ASIA BRAVERY | 14 | 69 |
| ASIA LOYALTY | 14 | 86 |
| ATHEL LAADKI | 19 | 144 |
| AUGUSTENBURG | 1 | |
| AUSTRAL ENTENTE | 6 | |
| AUSTRAL PATRIOT | 19 | 66 |
| AVILA | 8 | 24 |
| AWJU | 14 | 57 |
| AWTT | | 38 |
| BARPONN | 6 | 29 |
| BASSWOOD WLB388 | 9 | |
| BEISHU MARU | | |
| BLUE CEDAR | 22 | 77 |
| BOHEME | 28 | 109 |
| BRAZOS | 28 | 77 |
| BUTTONWOOD WLB 936 | 34 | 116 |
| CADOGAN | 28 | |
| CAMPBELL WHEC 32 | 1 | |
| CARIBBEAN ENDEAVOUR | 42 | 89 |
| CAROLINA | 1 | |
| CHARLESTON | 32 | 109 |
| CHAVES | 18 | 19 |
| CHERRY VALLEY | 97 | 193 |
| CHEVRON BRUSSELS | 17 | 24 |
| CHEVRON COPENHAGEN | | 178 |
| CHEVRON GENOA | | 179 |
| CHEVRON LOUISIANA | 10 | 188 |
| CHEVRON OREGON | 26 | 33 |
| CHEVRON WASHINGTON | | 3 |
| CITY OF DUNDEE | 34 | 84 |
| CLIFFORD MAERSK | 28 | |
| COLUMBIA RIVER L/V | 1 | |
| COMET | 427 | |
| CORAL ACE | 28 | 108 |
| CORSICANA | 32 | |
| CRISTOBAL | 42 | 69 |
| DALLAS WHEC 716 | 19 | 94 |
| DAVID P REYNOLDS | 34 | 27 |
| DEFIANCE | 91 | 180 |
| DELAWARE GETTY | 17 | 98 |
| DELTA AMERICA | 11 | 44 |
| DELTA ECUADOR | 1 | 4 |
| DELTA PANAGUAY | 18 | |
| DRVK | 9 | |
| DISCOVERER DSS | 140 | 72 |
| DOLLY TURMAN | 97 | 97 |
| DORIC | 6 | |
| DURABLE | 24 | 38 |
| DRCX | 34 | |
| DYDP | | 78 |
| EASTERN CHERRY | | 10 |
| EASTERN PACIFIC | 1 | |
| EASTERN WORLD | 17 | |
| EL PASO BONATRACH | 27 | |
| ELKE | 10 | 108 |
| ELIP | | 119 |
| EUROFREIGHTER | | 67 |
| EXPLORER | 46 | |
| EXPORT AMBASSADOR | | 148 |
| EXPORT BUYER | 1 | |
| EXPORT COURIER | 10 | 114 |
| EXXON BALTIMORE | 7 | 30 |
| EXXON CHESTER | 20 | 46 |
| EXXON HUNTINGTON | 8 | 8 |
| EXXON NEWARK | 8 | 9 |
| EXXON WASHINGTON | 31 | 98 |
| FLEETBANK | 1 | |
| FRIENDSHIP | 36 | 149 |
| GALLEON CORAL | 1 | |
| GEMINI | | 98 |
| GEORGE WALTON | 1 | 21 |
| GLACIER BAY | 28 | 134 |
| GLOMAR CHALLENGER | 29 | 103 |
| GOLDEN DAISY | 33 | 128 |
| GOLDEN LOTUS | 26 | 93 |
| GRAND CARRIER | 29 | 69 |
| GREEN AUKLET | 4 | 87 |
| GREEN SPRINGS | 17 | 88 |
| GULF BANKER | 9 | |
| GREEN SPRINGS | 19 | 88 |
| GUTENFELS | 7 | |
| HARDANGER | 18 | 31 |
| HARMINA | 18 | |
| HILLYER BROWN | 4 | 4 |
| HOEGH MERIT | 24 | 129 |
| HOEGH PILOT | 11 | 81 |
| HONGKONG PHOENIX | 17 | 74 |
| HOTAKA MARU | | 39 |
| HPHI | | 18 |
| HSHJ | | 94 |
| INGHAM WHEC 35 | 9 | 17 |
| ITALY MARU | | 17 |
| J T HIGGINS | | 147 |
| JAMES LYKES | 10 | 79 |
| JAPAN RAINBOW | | 84 |
| JEFF DAVIS | 1 | 18 |
| JLJL | | 59 |
| JOHN LYKES | 10 | 89 |
| JUPITER | 47 | |
| KATHY | 2 | |
| KERA | | 19 |
| KLGR | | 28 |
| KOREA PHOENIX | 8 | |
| KRPN | 9 | |
| KVSG | | 27 |
| LAKE SHASTA | 4 | |
| LASH PACIFICO | 6 | 24 |
| LELAND I ODAN | 1 | |
| LIECHTENSTEIN | 6 | |
| LNCV | | 84 |
| ACUSHNET WAGO 167 | 12 | 30 |
| AFRICAN CONEY | 17 | 77 |
| AFRICAN NEPTUNE | 4 | 49 |
| ALASKA STANDARD | 19 | 90 |
| ALERT | 2 | |
| ALMERIA LYKES | 49 | 181 |
| ALVINA | 18 | 19 |
| AMERICAN ACE | 28 | 119 |
| AMERICAN ARCHER | 44 | 111 |
| AMERICAN CHALLENGER | 2 | 24 |
| AMERICAN CORSAIR | 9 | 25 |
| AMERICAN LARK | 21 | 148 |
| AMERICAN LEGION | 21 | 118 |
| AMERICAN RANGER | 28 | 67 |
| ANCHORAGE | 4 | 14 |
| ANNA MAERSK | 31 | 79 |
| AQUILA | 28 | 28 |
| ARCO MERITAGE | 19 | 33 |
| ARCO SAG RIVER | 64 | 109 |
| ARIZONA | 19 | 69 |
| ARTLENBURG | 91 | 68 |
| ASIA MERON | 19 | 38 |
| ASIA MORALITY | 10 | 14 |
| ATLANTIC BRIDGE | 6 | |
| AUSTIN | 1 | |
| AUSTRAL ENVOY | 18 | 72 |
| AUSTRAL PILGRIM | 9 | 31 |
| AXEL MAERSK | 28 | 74 |
| AZNA | | 43 |
| BARNES | 50 | |
| BARRANCA | 15 | 39 |
| BAYAMON | | 21 |
| BELLA MAERSK | 9 | |
| BLUMSIRD | | 71 |
| BORINQUEN | 60 | 128 |
| BRENSTER | 19 | 26 |
| C V LIGHTNING | 10 | |
| CALIFORNIA RAINBOW | 10 | 97 |
| CAPTAIN COOK | 2 | |
| CARIBE SEABRIST | 19 | |
| CARMEN A | 11 | 84 |
| CHARLOTTE LYKES | 19 | 120 |
| CHENNAI SADHANA! | | 72 |
| CHEVRIER | 23 | 47 |
| CHEVRON BURNABY | 1 | 192 |
| CHEVRON EDINBURGH | 3 | 161 |
| CHEVRON HAWAII | 42 | 103 |
| CHEVRON MISSISSIPPI | 59 | 114 |
| CHEVRON PERNIS | 54 | 160 |
| CHILBAR | 1 | |
| CIUDAD DE BUENAVENTURA | 1 | |
| CLOVER WLB 392 | 1 | |
| COLUMBUS AMERICA | 17 | 48 |
| CONALCO | 10 | 36 |
| CORANTIJN | 22 | 82 |
| COSMOS BIRNAM | 55 | 109 |
| CRYSTAL REED | 14 | |
| DANGOOD ICE | 26 | |
| DAVID PACKARD | | 21 |
| DEL ORO | 3 | 30 |
| DELAWARE II | 94 | |
| DELTA ARGENTINA | 10 | 39 |
| DELTA MAR | 3 | 25 |
| DELTA URUGUAY | 22 | 101 |
| DWCH | | 117 |
| DYYB SKOU | 29 | |
| DON CARLOS | 10 | 33 |
| DRUCILLA U | 39 | 63 |
| DSJP | | 84 |
| DSOH | | 85 |
| DYPJ | | 9 |
| EASTERN FORTUNE | 11 | |
| EASTERN SUN | 3 | |
| EASTWIND | 1 | |
| EL PASO SOUTHERN | 16 | 70 |
| ELNG | | 26 |
| ENNA G | 7 | 68 |
| EVER SPRING | 19 | 62 |
| EXPORT ADVENTURER | 1 | 68 |
| EXPORT BANNER | 2 | 48 |
| EXPORT CHALLENGER | 31 | 99 |
| EXPORT FREEDOM | 11 | 82 |
| EXXON BANGOR | 19 | 80 |
| EXXON FLORENCE | 13 | 39 |
| EXXON JAMESTOWN | 29 | 67 |
| EXXON PHILADELPHIA | 37 | 90 |
| FAIRWEATHER | 1 | |
| FORT HOSKINS | 1 | |
| FROSTFJORD | 3 | 32 |
| GALLEON JADE | 10 | 29 |
| GENE TREFETHEN | 78 | |
| GEORGIANA | 19 | |
| GLADIOLUS | 35 | 139 |
| GLOMAR PACIFIC | | 97 |
| GOLDEN EXPLORER | 25 | 18 |
| GOLDEN ROD | 4 | 47 |
| GREAT LAND | 44 | 101 |
| GREEN HARBOUR | 4 | 149 |
| GREEN VALLEY | 1 | |
| GULF FARMER | 13 | 39 |
| GREEN VALLEY | 1 | |
| GWIB | | 97 |
| HARRY LUNDEBERG | 23 | 104 |
| HESS TRADER | 8 | 34 |
| HOEGH GLEN | 9 | |
| HOEGH OPAL | 9 | |
| HOEGH PRIDE | | 48 |
| HONGKONG SUCCESS | 19 | 6 |
| HOUSTON | 2 | 14 |
| HPAL | | 16 |
| IRAMO | 10 | 81 |
| IRIS ISLAND | 34 | 91 |
| ITAPUCA | 8 | |
| JACKSONVILLE | 9 | 142 |
| JAPAN ACE | | 44 |
| JARVIS WHEC 725 | 13 | 820 |
| JELA TOPIC | 19 | 41 |
| JLUL | | 6 |
| JOHN TYLER | 19 | 47 |
| JUTHLANDIA | 22 | 49 |
| KBNG | | 14 |
| KEYSTONER | 92 | 172 |
| KOFWEU MARU | | 84 |
| KORBAN DIA | 8 | 19 |
| KRSV | | 20 |
| LAKE PUNKHOUSEN | 9 | 113 |
| LAKE TAHOE | 1 | |
| LAUREL | 32 | 85 |
| LBD | 15 | 15 |
| LIND YUNG | 49 | 75 |
| LNDL | | 134 |
| ADABELLE LYKES | 7 | |
| AFRICAN DAWN | 10 | 94 |
| AFRICAN SUN | 6 | 25 |
| ALASKAN | 46 | 120 |
| ALBUTIAN DEVELOPER | 17 | 32 |
| ALPHA HELIX | 3 | 86 |
| AMELIA TOPIC | 8 | 104 |
| AMERICAN ALLIANCE | 9 | 38 |
| AMERICAN ARGOSY | 19 | 72 |
| AMERICAN CHAMPION | 93 | 88 |
| AMERICAN COURIER | 32 | 90 |
| AMERICAN LEADER | 21 | 85 |
| AMERICAN LIBERTY | 39 | 167 |
| AMERICAN RELIANCE | 10 | 94 |
| ANCO DUKE | 109 | 131 |
| ANNIE JOHNSON | | 45 |
| ARCO ANCHORAGE | 76 | 104 |
| ARCO JUNEAU | 108 | 121 |
| ARCTIC TOKYO | | 67 |
| ARNOLD MAERSK | 19 | 31 |
| ASHLEY LYKES | 9 | 33 |
| ASIA HONESTY | 9 | 73 |
| ASIA ZEBRA | 34 | 100 |
| ATLANTIC HIGHWAY | 2 | |
| AUSTRAL ENDURANCE | 21 | 136 |
| AUSTRAL LIGHTNING | 44 | 102 |
| AUSTRAL PILOT | 7 | 83 |
| AXCU | | 38 |
| AZWB | | 101 |
| BALD BUTTE | 30 | 133 |
| BARTLETT ARCR 15 | 22 | |
| BAYAMO | 31 | 76 |
| BERGLJOT | 19 | 23 |
| BOGASARI SUA | 9 | 27 |
| BOSTON | 22 | 88 |
| BRINTON LYKES | 8 | 19 |
| C V STARGHUND | 23 | 95 |
| CALIFORNIAN | 37 | 90 |
| CARIBE SEABRIST | | 120 |
| CARMEN A | 9 | 27 |
| CHANCELLORSVILLE | 17 | 48 |
| CHASE WHEC 718 | 2 | 64 |
| CHERISH | 1 | |
| CHEVRON ANTWERP | 1 | 184 |
| CHEVRON CALIFORNIA | 24 | 72 |
| CHEVRON CELUY | 11 | |
| CHEVRON KENTUCKY | 94 | |
| CHEVRON NAGASAKI | 44 | |
| CHEVRON PERTH | 13 | 209 |
| CHRISTOPHER LYKES | 23 | 89 |
| CK APOLLO | 3 | |
| COLORADO | 99 | 246 |
| COLUMBUS AUSTRALIA | | 103 |
| CONDATA | 21 | 78 |
| CORNELIA MAERSK | 9 | 19 |
| COURAGEOUS WHEC 822 | | 39 |
| CRSG | | 69 |
| DAUNTLESS CG | 79 | 90 |
| DPPD | | 76 |
| DRL AID | 3 | 84 |
| DELAWARE SUN | 1 | 87 |
| DELTA BRASIL | 8 | 28 |
| DELTA MEXICO | 8 | 12 |
| DELTA VENEZUELA | 2 | |
| DIANA PROSPERITY | 18 | 189 |
| DJATISARI | 7 | |
| DON JUAN | 13 | 23 |
| DUANE | 42 | 67 |
| DENP | | 44 |
| DREH | | 94 |
| EAGLE | 38 | 92 |
| EASTERN JADE | 19 | |
| EASTERN TREASURE | 29 | 68 |
| EDELWEISS | 11 | |
| ELSY | | 181 |
| ELPA | | 29 |
| ERIDGE | 1 | |
| EVER SUNNIY | 14 | 98 |
| EXPORT AGENT | 10 | 41 |
| EXPORT BAY | 0 | |
| EXPORT CHAMPION | 11 | |
| EXPORT LEADER | 18 | 108 |
| EXXON BATON ROUGE | 16 | 43 |
| EXXON GETTYSBURG | 28 | 87 |
| EXXON LEXINGTON | 1 | |
| EXXON SAN FRANCISCO | 44 | 93 |
| FAIRWIND | 39 | 79 |
| FRANCIS SINGER NO 6 | 39 | |
| GAGE LUND | 101 | |
| GALVESTON | 39 | 91 |
| GENEVIEVE LYKES | 9 | 67 |
| GEORGINO | | 10 |
| GLOBAL FRONTIER | 1 | 89 |
| GLORIOUS SHINKO | 21 | |
| GOLDEN GATE | 41 | 60 |
| GOVANBANK | 19 | |
| GREAT OCEAN | 17 | 101 |
| GREEN ISLAND | 19 | 91 |
| GREEN WAVE | 12 | |
| GULF SHIPPER | 13 | 29 |
| GREEN WAVE | 12 | |
| GWIU | | 89 |
| HAWAIIAN CITIZEN | 19 | 39 |
| HESS VOYAGER | 19 | 98 |
| HOEGH MALLARD | 15 | 136 |
| HOEGH ORCHID | 9 | |
| HOEGH TRADER | 19 | 23 |
| HONSHU GLORIA | 30 | 104 |
| HOWARD W BELL | 26 | |
| HRBC | | 16 |
| ILLINOIS | 29 | 109 |
| IRIS QUEEN | 61 | |
| J LOUIS | 47 | 85 |
| JALAYAMINI | 2 | |
| JAPAN AMBROSE | | 81 |
| JOJE | | 71 |
| JWUZ | 3 | 59 |
| JOHANNA OLDENDORFF | | |
| JOSEPH HEWES | 24 | |
| KANA KEOKI | 19 | 84 |
| KEIYO | 20 | 58 |
| KHLN | | 103 |
| KOKUEI RETILAFF | 29 | |
| KOREAN LEADER | 18 | 72 |
| KSLJ | | 33 |
| LABRADOR CLIPPER | 1 | |
| LASH ATLANTICO | 30 | 80 |
| LAUREL WLB390I | 19 | |
| LESLIE LYKES | 3 | |
| LIONS GATE BRIDGE | | 29 |
| LNDH | | 19 |
| ADM WM M CALLAGHAN | 28 | 77 |
| AFRICAN MERCURY | 4 | 67 |
| AGUADILLA | 109 | 180 |
| ALBATROSS IV | 46 | |
| ALEX STEPHENS | | 18 |
| ALSTON EXPRESS | | 36 |
| AMERICA MARU | | 67 |
| AMERICAN APOLLO | 19 | 124 |
| AMERICAN ARROW | 91 | |
| AMERICAN CHALLENGER | 14 | 108 |
| AMERICAN INDEPENDENCE | 33 | 48 |
| AMERICAN LEGACY | 29 | 72 |
| AMERICAN LYNX | 7 | 97 |
| AMERICAN TRADER | 13 | 71 |
| ANCO STONE | 24 | |
| ANITA TOPIC | 3 | |
| ARCO ENTERPRISE | 29 | 61 |
| ARCO PRESTIGE | 10 | 6 |
| ARECIBO | 34 | 138 |
| ARTHUR MAERSK | 17 | 65 |
| ASIA BEAUTY | 34 | 72 |
| ASIA HUNTER | 6 | |
| ASIAN TRANSPORTER | 12 | |
| ATLANTIC PIONEER | 12 | 109 |
| AUSTRAL ENSIGN | 37 | 100 |
| AUSTRAL MOON | 41 | 122 |
| AUSTRAL RAINBOW | 37 | 98 |
| AXPD | | 40 |
| AZWR | | 70 |
| BALTIMORE TRADER | 17 | 96 |
| BARNA | 14 | 24 |
| BEGONIA | 49 | |
| BIRD WHEC 31 | 2 | |
| BOGASARI BRU | | 83 |
| BOUTWELL WHEC 719 | 101 | 179 |
| BUNGA SRIPAGI | 6 | |
| C.W. KITTO | | 39 |
| CAMELLIA VENTURE | 1 | 19 |
| CARIBBEAN CARRIER | 2 | |
| CARNIVALE | 87 | 89 |
| CHARLES PIGOTT | 34 | 197 |
| CHASTINE MAERSK | 16 | 89 |
| CHEROKEE WHEC 149 | 31 | 82 |
| CHEVRON ARIZONA | 38 | 82 |
| CHEVRON COLORADO | 30 | 72 |
| CHEVRON FRANKFURT | | 173 |
| CHEVRON OREGON | | 207 |
| CHEVRON NORTH AMERICA | 1 | 103 |
| CHEVRON SOUTH AMERICA | 11 | 107 |
| CITRUS WLB390 | 17 | 96 |
| CLARA MAERSK | 9 | |
| COLUMBIA | 1 | |
| COLUMBUS NEW ZEALAND | | 108 |
| CONTESA | 1 | |
| CORNUCOPIA | 17 | 66 |
| CRESSIDA | 21 | 69 |
| DA VERRAZANO | 9 | |
| DAVID D. IRWIN | 32 | 42 |
| DEEPSEA MINER II | 3 | 24 |
| DEL SOL | 18 | 72 |
| DELTA AFRICA | 2 | 9 |
| DELTA CARIBE | 43 | 112 |
| DELTA PANAMA | | 81 |
| DEPENDABLE WHEC 836 | 9 | 86 |
| DILIGENCE WHEC 816 | 9 | |
| DOCTOR LYKES | 32 | 148 |
| DONA CONCEPCION II | | 87 |
| DUBHE | 12 | |
| DRBH | | 22 |
| DTGP | | 14 |
| EASTERN BRIDE | 39 | 62 |
| EASTERN MUSE | 10 | |
| EASTERN WISEMAN | 6 | |
| EDGAR M QUEENY | 18 | 69 |
| ELIZABETH LYKES | 18 | 93 |
| ELPJ | | 47 |
| ERGO KORE | 9 | |
| EVERGREEN WAGO-199 | 9 | 4 |
| EXPORT AIDE | 2 | 19 |
| EXPORT BUILDER | 1 | 93 |
| EXPORT COMMERCE | 31 | |
| EXPORT PATRIOT | 20 | 119 |
| EXXON BOSTON | 11 | 29 |
| EXXON HOUSTON | 39 | 103 |
| EXXON NEW ORLEANS | 10 | 19 |
| EXXON SEATTLE | 38 | 101 |
| FAIRTRIX | 17 | 98 |
| FREDERICK LYKES | 29 | 35 |
| GALLATIN WHEC 721 | | 87 |
| GARYMORVOO | 36 | 23 |
| GEORGE M KELLER | 7 | 176 |
| GIBRALTAR PANSY | 28 | |
| GLOBAL MARITIME | 43 | |
| GOLDEN ARROW | | 67 |
| GOLDEN GATE BRIDGE | | 91 |
| GRACE | 13 | |
| GREAT REPUBLIC | 11 | 63 |
| GREEN LAKE | 21 | 71 |
| GUAYAMA | 43 | 124 |
| GULF TRADER | 19 | 48 |
| GUAYUPA | 49 | 124 |
| HAKONE MARU | | 67 |
| HAWAIIAN SUBSH | 43 | 98 |
| HIKI MARU | | 47 |
| HOEGH HASCOT | | 73 |
| HOESH ORRIS | 81 | |
| HOLYLIGHT | | 13 |
| HOPH | | 42 |
| HOWELL LYKES | 8 | 45 |
| HUMACAO | | 49 |
| INGER | 26 | 144 |
| IRONWOOD WLB 297 | 26 | 98 |
| J R GRAY | 9 | 197 |
| JAMES B O'BRIEN | 18 | |
| JAPAN CACHO | 12 | 112 |
| JEAN LYKES | 18 | 49 |
| JKMG | | 10 |
| JOHN B WATERMAN | 11 | 98 |
| JOSEPH LYKES | 1 | 32 |
| KASHU MARU | | 84 |
| KENTUCKY MORE | 2 | |
| KINGDOM VENTURE | 14 | |
| KSPAA | 24 | 67 |
| KOREAN PRIDE | 9 | |
| KVSE | | 9 |
| LAKE PALOURDE | 14 | 92 |
| LASH ITALIA | 11 | 68 |
| LAURIE U | 2 | |
| LETITIA LYKES | 9 | 116 |
| LIRCAY | | 80 |
| LONG BEACH | 11 | 86 |

TOTAL WEATHER REPORTS RECEIVED FROM US COOPERATIVE OBSERVING SHIPS SEPTEMBER AND OCTOBER 1978

| SHIP NAME | VIA RADIO | VIA MAIL |
|---|---|---|
| LONG LINES | 9 | |
| LUIGI GRIMALDI | 38 | 44 |
| MALLORY LYKES | 41 | 71 |
| MAMMOTH PINE | 4 | 11 |
| MANUKAI | 36 | 133 |
| MAR TIERRA | | 21 |
| MARCONA TRANSPORTER | 13 | 100 |
| MARGIT BROVIG | 1 | |
| MARITIME FORTUNE | 9 | |
| MARJORIE LYKES | 10 | 26 |
| MATHIASON | | 24 |
| MAYAGUEZ | 53 | 102 |
| MEDNIA | 34 | 104 |
| MIDAS BRINE | 8 | |
| MING YOUNG | 17 | 27 |
| MOBIL LUBE | 13 | 31 |
| MOBILE MERIDIAN | 19 | 39 |
| MODOC WMEC-194 | 21 | |
| MONTERREY | 9 | |
| MORGENTHAU WMEC 722 | | 199 |
| MORMACGLEN | 18 | |
| MORMACSEA | 5 | 47 |
| MORMACVEGA | 27 | 30 |
| MOUNT VERNON VICTORY | | 37 |
| MSCMEX | 38 | 39 |
| NEW ENGLAND TRAPPER | | 164 |
| NNNP | | 49 |
| NOPAL SEL | 12 | 19 |
| NORDIC LOUISIANA | 21 | |
| NOTS | | 14 |
| OCEAN HARMONIA | 1 | |
| OETA | 10 | 16 |
| OGDEN JORDAN | 4 | |
| OJI GLORIA | 60 | |
| ONANGE | 35 | |
| ORE VENUS | | 120 |
| ORIENTAL EXECUTIVE | 17 | 69 |
| ORIENTAL SOVEREIGN | 28 | 97 |
| OUHO | | 51 |
| OVERSEAS JUNEAU | 35 | 104 |
| OVERSEAS ULLA | 17 | |
| OYOC | | 7 |
| PACDUKE | 8 | |
| PACIFIC ACE | | 91 |
| PACIFIC VENTURE | 48 | 128 |
| PACMAJESTY | 9 | 17 |
| PACPRINCESS | 19 | |
| PAN ALIANCE | 47 | 94 |
| PAUL L PAHRNEY | | 178 |
| PHILIPPINE PRES QUIRIN | | 19 |
| PHILLIPS OREGON | 1 | |
| PIONEER CONTENDER | 23 | 62 |
| PKIA | | 12 |
| PORTLAND | 42 | 113 |
| PRESIDENT ADAMS | 10 | 78 |
| PRESIDENT HARRISON | 34 | 130 |
| PRESIDENT KENNEDY | 28 | 88 |
| PRESIDENT PIERCE | 36 | 138 |
| PRESIDENT TAFT | 36 | 104 |
| PRESIDENT WILSON | 9 | 36 |
| PROSPERITY | 9 | |
| PVT JOHN R TOWLE | 9 | 23 |
| QUIXADA | | 7 |
| REGENT LOTUS | 1 | |
| REVERE | 58 | 113 |
| RIO LOS SAUCES | | 9 |
| ROBERT YOUNGS | 8 | |
| ROSE CITY | 31 | 142 |
| RUTH LYKES | 4 | 47 |
| SAMUEL CHASE | 8 | 66 |
| RUTH LYKES | 4 | 47 |
| SAN MARCOS | 49 | 77 |
| SANTA BARBARA | 4 | 4 |
| SANTA MARIA | 28 | 70 |
| SCHUYLER OTIS BLAND | 9 | |
| SEALAND CONSUMER | 32 | |
| SEALAND GALLOWAY | 23 | 86 |
| SEALAND RESOURCE | 28 | 82 |
| SEALIFT PACIFIC | 3 | |
| SEATRAIN LEXINGTON | 61 | 161 |
| SENTINEL | 28 | 81 |
| SEVEN OCEAN | 20 | 101 |
| SWING ON | 37 | |
| SINGERE NO 3 | | 104 |
| SMYRNA | 12 | 23 |
| SMOOTH VACUUM | 1 | 33 |
| SPERO | 12 | |
| STAR HONGKONG | 23 | |
| STELLA LYKES | 28 | 85 |
| STREAM HANGER | 6 | |
| SUGAR ISLANDER | 11 | |
| SURVEYOR | 9 | 33 |
| SWZ | | 171 |
| T S PETERSEN | 2 | |
| TAMPA | 32 | 67 |
| TCCH | | 41 |
| TEXACO MARYLAND | 11 | 36 |
| TEXACO RHODE ISLAND | 14 | |
| THOMAS JEFFERSON | 8 | 21 |
| THOMPSON LYKES | 11 | 36 |
| TOMBEI MARU | | 34 |
| TOWNSEND CROMWELL | 31 | 139 |
| TRANSCHAMPLAIN | 47 | 186 |
| TREIN MAERSK | 4 | 19 |
| TUNISIAN MARINER | 9 | 32 |
| UNION CONCORD | 18 | 34 |
| UYE ATP 76 | 11 | 88 |
| VAN ENTERPRISE | 40 | 144 |
| VELMA LYKES | 29 | |
| VICTORIA U | 24 | |
| VIRGINIA STAR | 29 | 89 |
| WASHINGTON TRADER | 31 | 78 |
| WECONA | 42 | 86 |
| WEVI | | 31 |
| WILMINGTON GETTY | 57 | 107 |
| WLJO | | 81 |
| WORLD STANDARD | 1 | |
| WPPV | | 63 |
| YEH YUNG | 42 | 18 |
| YYNG | | 36 |
| ZCLV | | 21 |
| ZIM TOKYO | 41 | 80 |
| 3BBR | | 8 |
| 3FAS | | 15 |
| 3LTY | | 17 |
| 6ONA | | 14 |
| 6ZMT | | 1 |
| LOUISE | 49 | 101 |
| LURLINE | 61 | 68 |
| MALLOW WLB 996 | 19 | 16 |
| MANHATTAN | 39 | 78 |
| MANULANI | 60 | 135 |
| MARCHEN MAERSK | 1 | |
| MARDI GRAS | 31 | 48 |
| MARIA TOPIC | | 9 |
| MARITIME INVESTOR | 15 | |
| MARSHFIELD | | 93 |
| MAYBONIA | 58 | 145 |
| MEADOWBROOK | 17 | 105 |
| MERCY | 1 | |
| MILLER FREEMAN | 2 | |
| MOBIL ARCO | 13 | 91 |
| MOBIL POWER | 6 | 82 |
| MOBILFUEL | | 17 |
| MOHAWK | 12 | 52 |
| MONTIROM | 4 | |
| MORMACALTAIR | 17 | 26 |
| MORMACLYNX | 16 | 32 |
| MORMACSKY | 28 | 116 |
| MORMACWAVE | 19 | |
| MT MITCHELL | 58 | 138 |
| NEPTUNE RUBY | 15 | |
| NEW JERSEY SUN | 1 | 39 |
| NNOB | | 19 |
| NORMU | 3 | |
| NORSE PILOT | 26 | |
| NTRI | | 167 |
| OCEAN HOPE | 3 | |
| ODDEN CHALLENGER | 4 | |
| ODDEN THAMES | 33 | |
| OLGA TOPIC | 14 | |
| OMCO TRADER | 9 | 21 |
| ORIENTAL AMIGA | 10 | |
| ORIENTAL PINANCIER | 16 | 31 |
| ORIENTAL STATESMAN | 18 | |
| OVERSEAS ALASKA | 12 | |
| OVERSEAS NATALIE | 27 | 90 |
| OVERSEAS VALDEZ | 11 | 35 |
| OYIK | | 33 |
| PACENPEROR | 3 | |
| PACIFIC ARROW | | 83 |
| PACIFIC WING | 35 | 104 |
| PACMERCHANT | 11 | 14 |
| PACQUEEN | 2 | |
| PAN ASIA | 14 | 11 |
| PAYSANDU | 38 | |
| PHILIPPINE RIZAL | | 9 |
| PINK LADY | 24 | |
| PIONEER CONTRACTOR | 9 | 80 |
| PLANTREE WLB 307 | 11 | |
| PORTUGAL MARU | | 80 |
| PRESIDENT CLEVELAND | 18 | 24 |
| PRESIDENT JACKSON | 19 | 35 |
| PRESIDENT MADISON | 66 | 106 |
| PRESIDENT POLK | 36 | 141 |
| PRESIDENT TAYLOR | 32 | 32 |
| PRINCE WILLIAM SOUND | 30 | 83 |
| PROSPERITY QUEEN | 21 | 84 |
| PVT LEONARD C BROSTROM | 6 | |
| RACHEL | 10 | |
| REGINA CELI | 17 | |
| RICHARD | 53 | 83 |
| RIO PILCOMAYO | | 18 |
| ROBERTSBANK | | 14 |
| ROYAL VIKING SEA | | 4 |
| S P LEE | 23 | 106 |
| SAMUEL B | 14 | 19 |
| S P LEE | 23 | 106 |
| SAND SHORE | 29 | 87 |
| SANTA CLARA | 29 | 127 |
| SANTA MARIANA | 16 | |
| SEA PAN | 10 | 22 |
| SEALAND ECONOMY | 17 | 116 |
| SEALAND MARKET | 23 | 84 |
| SEALAND TRADE | 40 | 110 |
| SEATIGER | 39 | 84 |
| SEATRAIN PRINCETON | | 131 |
| SEPTA | 3 | |
| SPLT | | 28 |
| SMIRLEY LYKES | 12 | 82 |
| SINGERE NO 9 | 4 | |
| SNOW BALL | 2 | |
| SOLON TURMAN | 15 | |
| SPRINGBANK | 1 | |
| STAR MALMANGER | 4 | |
| STOUT LLANDAFF | 3 | |
| STREAM RUDDER | 1 | |
| SUNNY OCEAN | 6 | 65 |
| SUSAN MAERSK | 4 | |
| SWA | | 29 |
| TAI YUNG | 22 | |
| TANEY WMEC 37 | 120 | 132 |
| TENADORES | 1 | |
| TEXACO MASSACHUSETTS | 7 | 17 |
| TEXAS SUN | 1 | 109 |
| THOMAS LYNCH | 7 | |
| TILLIE LYKES | 6 | 14 |
| TOKYO RAINBOW | 15 | 67 |
| TOYOTA MARU 10 | | 93 |
| TRANSCOLORADO | 19 | 85 |
| TRINITY | 16 | 37 |
| TYSLA | 12 | |
| UNITED SPIRIT | 12 | 7 |
| VALIANT | | 39 |
| VAN TRIUMPH | 7 | 31 |
| VENTUROUS WMEC 625 | 1 | |
| VIGOROUS WMEC-627 | | 61 |
| VOLNAY | 33 | |
| WAYFARER | 11 | 6 |
| WESTERN SUN | | 72 |
| WPGB | | 19 |
| WLOV | | 16 |
| WORLD CHAMPION | 2 | |
| WORTH | 11 | 39 |
| XCSY | | 71 |
| YOKOHA WMEC 168 | 13 | 49 |
| YUKON T-AO 182 | 14 | 26 |
| ZCUT | | 67 |
| ZOELLA LYKES | 39 | 84 |
| 2PCH | | 44 |
| 3JEN | | 21 |
| 3LYO | | 9 |
| 6YZJ | | 14 |
| 6ZXD | | 39 |
| LOUISE LYKES | 11 | 77 |
| MAGDALENA | 68 | |
| MALMARE MONSOON | | 61 |
| MANISTEE | 92 | 30 |
| MANZANARES | 1 | |
| MARCONA CONVEYOR | 78 | 178 |
| MARGARET JOHNSON | | 48 |
| MARIAS TAO-87 | | 48 |
| MARITIME JUSTICE | 7 | 73 |
| MASON LYKES | 7 | 58 |
| MAUI | 41 | 127 |
| MEDIOLANUM | 1 | |
| MEYRON T-AKR 9 | 90 | 57 |
| MINERVA | 1 | |
| MOBIL ARCTIC | 58 | 114 |
| MOBIL VENTURE | 1 | |
| MOBILGAS | 2 | 14 |
| MONMOUTH | 6 | 62 |
| MONTPELIER VICTORY | 14 | 98 |
| MORMACARGO | 28 | 90 |
| MORMAIGEL | 17 | 62 |
| MORMACSUN | 37 | 69 |
| MORNING GLORY | 1 | |
| NANCY LYKES | 9 | |
| NEVADA | 34 | 92 |
| NEWARK | 51 | 128 |
| NOPAL BRANCO | 24 | 28 |
| NORDWIND | 42 | |
| NORTH STAR III | 49 | 136 |
| NSIN | | 39 |
| OCEANIC | 109 | 172 |
| ODDEN CONGO | 4 | |
| ODDEN WABASH | 10 | 89 |
| OLIVIA MAERSK | 1 | |
| ORE JUPITER | 26 | 12 |
| ORIENTAL COMMANDER | 18 | 63 |
| ORIENTAL LEADER | 28 | 73 |
| OSCO SIERRA | 39 | 88 |
| OVERSEAS ARCTIC | 14 | 67 |
| OVERSEAS NEW YORK | 8 | 30 |
| OVERSEAS WASHINGTON | 28 | 20 |
| PACBARON | 4 | |
| PACGLORY | 30 | 21 |
| PACIFIC ERA | 97 | |
| PACKING | 2 | |
| PACMONARCH | 6 | |
| PACSTAR | 16 | 48 |
| PARALLA | 9 | 11 |
| PENMAR | 8 | |
| PHILLIPS NEW JERSEY | 1 | |
| PINK ICE | 4 | |
| PIONEER CRUSADER | 86 | 122 |
| POLAR ALASKA | | 85 |
| POTOMAC | 6 | 19 |
| PRESIDENT EISENHOWER | 80 | 139 |
| PRESIDENT JEFFERSON | 46 | 185 |
| PRESIDENT MC KINLEY | 49 | 119 |
| PRESIDENT QUEZON | | 17 |
| PRESIDENT TRUMAN | 47 | 129 |
| PROGRESSUS | 1 | |
| PUERULA | 8 | |
| QUEENS WAY BRIDGE | | 74 |
| RAINIER | 6 | 6 |
| RESEARCHER | 80 | 90 |
| RIOLETTO | 19 | 22 |
| RIO TUXPAN | 3 | |
| ROMANDIE | | 131 |
| ROYAL VIKING STAR | 23 | 33 |
| SAM HOUSTON | 11 | 79 |
| SAN FRANCISCO | | 86 |
| SAM HOUSTON | 11 | 79 |
| SANKORUM | 9 | |
| SANTA ELISABETTA | | 48 |
| SANTA MERCEDES | 12 | 61 |
| SEABONDER | 9 | 27 |
| SEALAND EXCHANGE | 35 | 103 |
| SEALAND MCLEAN | 29 | 91 |
| SEALAND VENTURE | 21 | 103 |
| SEATRAIN BUNKER HILL | | 99 |
| SEATRAIN VALLEY FORGE | 21 | |
| SERRAPIN TOPIC | | 17 |
| SOPV | | 81 |
| SMUNWIND | 29 | 96 |
| SINCLAIR TEXAS | 32 | 141 |
| SNOW STORM | 14 | 24 |
| SONGKHLA | 26 | 101 |
| SPRUCE | 18 | 126 |
| STARWARD | 10 | 1 |
| STONEWALL JACKSON | 1 | |
| STRINDA | 11 | 44 |
| SUNNY STATE | 27 | 66 |
| SVENDBORG MAERSK | 33 | 79 |
| T P L INDEPENDENCE | 3 | 24 |
| TAIKO VENTURE | 26 | 19 |
| TARPON | 2 | 121 |
| TEXACO FLORIDA | 19 | 28 |
| TEXACO MISSISSIPPI | 7 | 14 |
| TEXAS TRADER | 13 | 89 |
| THOMAS NELSON | 3 | 31 |
| TIRRANNA | 3 | |
| TOLUCA | 3 | |
| TOYOTA MARU 12 | | 44 |
| TRANSCOLUMBIA | 20 | 63 |
| TRIUMPH | 33 | 60 |
| ULTRASEA | 3 | |
| UNIVERSE | 14 | 45 |
| VALLEY FORGE | 17 | 11 |
| VAN WARRIOR | 37 | 112 |
| VERRAZANO BRIDGE | | 84 |
| VILLANGER | 4 | |
| WALTER RICE | 39 | 135 |
| WCCC | | 47 |
| WESTWARD VENTURE | 40 | 94 |
| WWBC | | 26 |
| WLGV | | 24 |
| WORLD MEDAL | 14 | |
| WTSO | | 1 |
| XCYS | | 93 |
| YOUNG AMERICA | 21 | 86 |
| ZAPATA ROVER | 6 | |
| ZIM HONGKONG | 18 | 86 |
| 3BBA | | 37 |
| 3FBW | | 12 |
| 3LLR | | 38 |
| 3MHB | | 7 |
| 6ZCY | | 40 |
| 9VBV | | 183 |
| LARY | | 3 |
| MAING | 29 | 93 |
| MAMMOTH PIR | 38 | 87 |
| MANUAWILI | 67 | 77 |
| MAR CARIBE | 1 | |
| MARCONA EXPORTER | 13 | 168 |
| MARGARET LYKES | 12 | 96 |
| MARITIME ACE | 6 | |
| MARITIME QUEEN | | 25 |
| MASSACHUSETTS | 38 | 80 |
| MAUMEE | 38 | 118 |
| MENINA ALICE | 11 | |
| MICHIGAN | 21 | 63 |
| MING LEADER | 17 | |
| MOBIL ENGINEER | 38 | 93 |
| MOBILE | 10 | 13 |
| MOBILOIL | 2 | |
| MONTANA | 35 | 97 |
| MOON RIVER | 2 | |
| MORMACSACO | 21 | 76 |
| MORMACSAGA | 9 | 93 |
| MORMACTIDE | 32 | 70 |
| MOUNT RAINIER | 18 | |
| NAUE | 3 | |
| NEW ENGLAND HUNTER | | 99 |
| NEWCASTLE CLIPPER | 5 | |
| NOPAL LAKE | 6 | |
| NORDIC CHIEFTAIN | 1 | |
| NORTHWIND WAGB 282 | 104 | 280 |
| OCEAN GUIDE | 23 | |
| OCEANOGRAPHER | 79 | 116 |
| OGDEN FRASER | 8 | |
| OGDEN WILLAMETTE | 16 | 78 |
| OPHELIA | 10 | |
| ORE MERIDIAN | 71 | 139 |
| ORIENTAL EDUCATOR | 46 | 181 |
| ORIENTAL QUEEN | 10 | |
| OTTO N. MILLER | | 96 |
| OVERSEAS JOYCE | 13 | 83 |
| OVERSEAS OHIO | 9 | 27 |
| OWYZ | | 32 |
| PACDUCHESS | 8 | |
| PACIFIC | | 3 |
| PACIFIC SAGA | 42 | 109 |
| PACLADY | 4 | 34 |
| PACPRINCE | 2 | |
| PALLAS | 17 | |
| PASSUMPSIC AO-107 | | 48 |
| PHILADELPHIA | 48 | 145 |
| PHILLIPS OKLAHOMA | 7 | |
| PIONEER COMMANDER | 6 | 12 |
| PIONEER MOON | 2 | 48 |
| PONCE | 23 | 34 |
| PPOI | | 17 |
| PRESIDENT FILLMORE | 48 | 63 |
| PRESIDENT JOHNSON | 34 | 107 |
| PRESIDENT MONROE | 2 | 86 |
| PRESIDENT ROOSEVELT | 30 | 126 |
| PRESIDENT VAN BUREN | 39 | 132 |
| PROSPECTOR | | 5 |
| PURE OIL | 27 | 133 |
| QUINTINA | 9 | 23 |
| RED JACKET | 7 | 60 |
| RESOLUTE WPC 620 | 34 | |
| RIO ARAUCAN | | 10 |
| ROBERT E LEE | 16 | 31 |
| ROSE | | 95 |
| RUSH WMEC 723 | 19 | 31 |
| SAMDAN REEFER | 3 | |
| SAN JUAN | 72 | 148 |
| SAMDAN REEFER | 3 | |
| SANSINENA II | 33 | 60 |
| SANTA MAGDALENA | 38 | 86 |
| SANTA PAULA | 19 | |
| SEALAND COMMERCE | 47 | 134 |
| SEALAND FINANCE | 27 | 84 |
| SEALAND PRODUCER | 26 | 129 |
| SEALIFT ATLANTIC | 6 | |
| SEATRAIN CONCORD | | 123 |
| SELANDIA | | 130 |
| SETI | | 80 |
| SHELDON LYKES | | 84 |
| SILVERLINE | | 31 |
| SUDA | | 44 |
| SNOWLAND | 24 | 68 |
| SOUTHWARD | 28 | 32 |
| STADT BREMEN | | 1 |
| STEADFAST WMEC 623 | 1 | |
| STORIS WAGB 38 | 11 | |
| SUCCESSFUL VENTURE | 7 | 13 |
| SUNWARD | 3 | 32 |
| SWEETBRIER WLB 405 | 1 | |
| T P L LIBERTY | 23 | 78 |
| TAMARA | 41 | |
| TASMANIC | 20 | 103 |
| TEXACO GEORGIA | | 80 |
| TEXACO NEW YORK | 16 | 87 |
| THOMAS G THOMPSON | 37 | 88 |
| THOMAS WASHINGTON | 27 | 93 |
| TOBIAS MAERSK | 4 | 47 |
| TONAMI MARU | | 34 |
| TOYOTA NO 24 | 28 | 9 |
| TRANSGEORGIA | 55 | 144 |
| TROPICANA | 14 | |
| UNIMAK WTR-379 | | 69 |
| UNIVERSE KURE | 19 | 140 |
| VAN CONQUEROR | 32 | 132 |
| VANGUARD | 12 | 104 |
| VICENTE GUERRERO | 11 | 19 |
| VIOLET | 44 | 89 |
| WASHINGTON RAINBOW | | 93 |
| WCHO | | 47 |
| WESTWIND WAGB 281 | 43 | 42 |
| WHITING | 37 | |
| WLIP | | 65 |
| WORLD RUBY | 18 | |
| WYOMING | 21 | 39 |
| YAMASHIN MARU | | 81 |
| YOUNG SEAGULL | 5 | 48 |
| ZCKV | | 66 |
| ZIM NEW YORK | 28 | 143 |
| 3BSH | | 7 |
| 3PUH | | 39 |
| 3LYA | | 71 |
| 3RUB | | 48 |
| 6ZKB | | 39 |

SUMMARY: GRAND TOTAL VIA RADIO 17635 GRAND TOTAL VIA MAIL 82479

# Rough Log, North Atlantic Weather

## December 1978 and January 1979

ROUGH LOG, DECEMBER 1978--December was a rough month for shipping on the North Atlantic. There was a major departure from climatology in the storm tracks once they passed off the North American west coast between latitudes 40° and 50°N. Climatology indicates two primary paths over water, one northward into the Labrador Sea and the other northeastward over Iceland. This month the primary path moved eastward from Nova Scotia to the United Kingdom. There was a secondary path from off the Carolinas to the Iberian Peninsula. There was also a secondary path that branched off the primary path south of Iceland and moved northward. Several storms turned westward north of latitude 55°N. One of these traveled westward from 25° to 55°W. Three cyclone centers tracked across the Mediterranean Sea.

The mean sea-level-pressure pattern reflected the storm tracks. It also differed widely from climatology. The Icelandic Low at 990 mb was many miles southeast of its 1000-mb climatic position. Normally, it is near 61°N, 30°W. This month it was near 53°N, 22°W. This also resulted in the Azores High being about 10° latitude south of its normal position. The normal High over the Greenland icecap was 5 mb higher than usual and off the east coast. There was also an anomalous 1021-mb High over the Gulf of Bothnia.

There were two large primary anomaly centers. The one that affected the primary shipping lanes was minus 21 mb near 49°N, 20°W. The other was plus 15 mb near Jan Mayen Island. The zero isoline approximately paralleled latitude 60°N between Greenland and Scotland.

The upper air pattern at 700 mb was completely zonal from coast to coast between 30° and 50°N. There were three low centers between 50° and 60°N spread from Hudson Bay to south of Iceland. There was a completely anomalous closed High over the east coast of Greenland at 70°N. The long-wave trough normally over the U.S. East Coast was over the Plains States. The usual slight ridge west of Europe did not exist. The locations of the anomaly center closely matched those at sea level.

Extratropical Cyclones--This first storm had its genesis over Ontario on the 2d out of a shallow trough. On the 3d the storm moved over Cape Race, and several ships including the DART AMERICA found 50-kn winds south of Cabot Strait. By 1200 on the 4th, the 954-mb malestrom was at 53°N, 39°W (fig. 47). OWS Charlie had 60-kn winds and 23-ft waves. The SUGAR REFINER also found 60-kn winds with 30-ft waves near 50°N, 43°W. Many ships had winds in the 45- to 50-kn range with at least three reporting 33-ft swell waves. On the 5th and 6th, the LOW stalled near 54°N, 38°W. Winds of 40 to 50 kn and waves of 20 to 30 ft continued through the 6th. Early on the 7th the LOW dissipated as the next one described became the primary circulation center.

This vicious LOW formed as a frontal wave south of the above-described LOW on the 6th. It turned northward late that day to eventually turn westward and end over the Labrador Sea. The LONDON VISCOUNT at 43°N, 24°W, was in the warm sector with westerly 55-kn winds and 25-ft waves. The ARCTIC TROLL was southeast of the cold front (41°N, 30°W) and pounded by 60-kn winds and 33-ft swells. On the 7th the DART ATLANTIC (45°N, 30°W) had 60-kn winds and 36-ft waves. Six hours earlier they had been 41 ft.

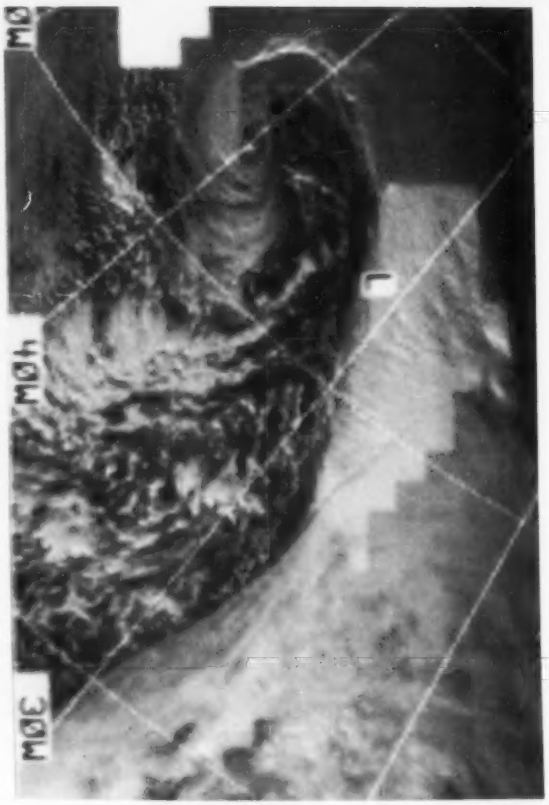


Figure 47.--The clouds appear to be pouring into the center. The Sun appears to be reflected off the sharp break in the high clouds north of the center. (DMSP Imagery)

By 1200 this was the single LOW that dominated the ocean from shore to shore and from 30° to 70°N (fig. 48). The central pressure was 946 mb. There were over half a dozen reports of 50-kn winds and above in the southwest quadrant. The highest reported was 64 kn by the LONDON VISCOUNT. This ship and the SHACKLETON (42°N, 23°W) both reported 41-ft swell waves. The EXPORT LEADER was not far from OWS Romeo. At 1200 she reported swell waves of 57 ft, and at 1800 she reported 49 ft. Romeo had 33-ft waves at the time.

On the 8th the higher winds had shifted to east of

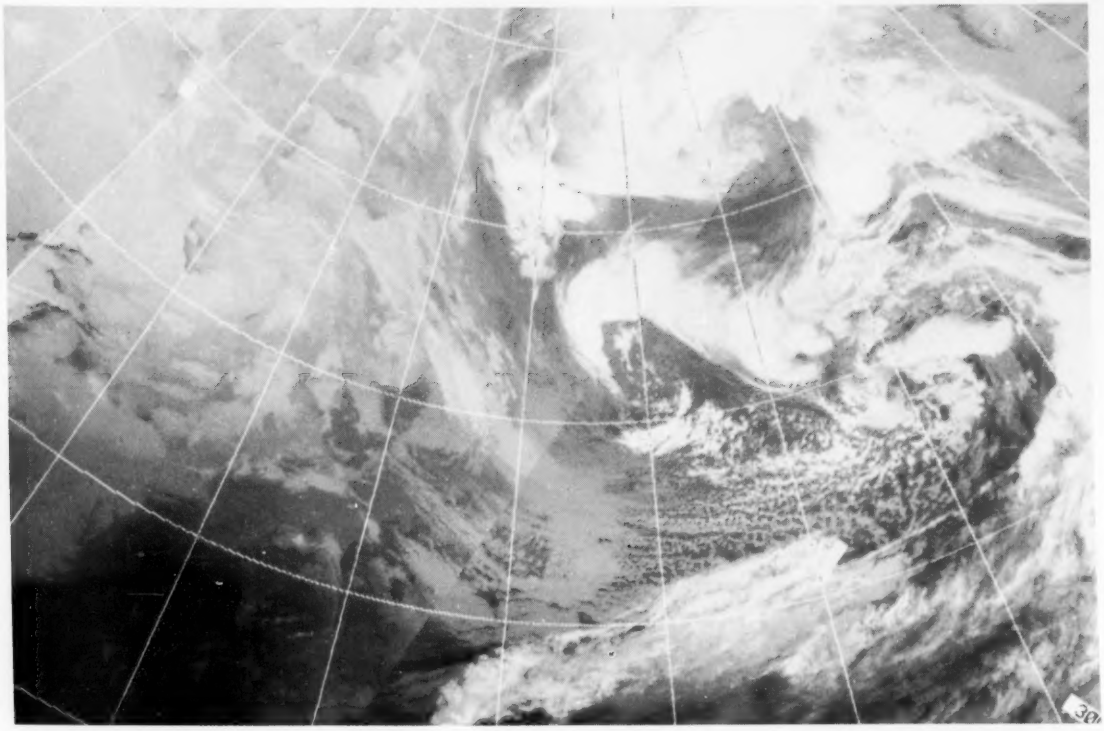


Figure 48.--This composite picture does not do this large storm justice. The clouds associated with it do not appear well organized. (DMSP Imagery)

the center over the North and Norwegian Seas. Waves up to 25 ft were still occurring south of the storm's latitude. At this time the storm began a westward trek. The central pressure was slowly rising.

Troughs and frontal waves were moving around the southern circulation. This led to a band of tight gradient between 35° and 40°N latitude. The waves were running about 20 ft. One of these frontal waves developed into the next described storm. The original LOW finally disappeared over the Labrador Sea on the 11th.

Monster of the Month--This storm was first analyzed on the 0600 chart of the 10th. At 1200 it was 960 mb near 46°N, 21°W (fig. 49). The ROBERTS BANK (40°N, 22°W) was devastated by 78-kn southwesterly winds and 41-ft swell waves. The ATLANTIC CAUSEWAY (44°N, 28°W) had 60-kn winds out of the west. At 0000 on the 11th, the storm was 952 mb near 46°N, 20°W. The ROBERTS BANK had sailed only about 20 mi in 12 hr

Figure 49.--The southern LOW was the culprit, but the northern one near 55°N contributed to the intensity of the larger circulation.

and now had 65-kn winds from 290°, 20-ft seas, and 46-ft swells from 270°. The SHACKLETON was closer to the center with 55-kn winds and 41-ft seas. Some of the highest wave reports during the day were 49 ft by the CITY OF LONDON (43°N, 10°W), 49 ft by the HOEGH MERCHANT (42°N, 16°W), and 52 ft by the HALIFAX STAR (46°N, 08°W).

The storm turned westward late on the 11th as the next severe LOW moved south of the center. It was difficult to distinguish which storm the high winds and waves were associated with, but to the ships involved it really did not matter. This second LOW had formed over Maryland as a frontal wave on the 9th. It raced eastward and deepened rapidly. On the 10th the HECTOR (37°N, 69°W) was sailing into 50-kn winds, 28-ft seas, and 39-ft swells. The 7,520-ton ELDANIA radioed a distress call at 0645 on the 11th from near Anticosti Island because of the storm and engine trouble. An hour later she was able to anchor and cancelled the distress call. At 1200 on the 11th the LOW was 964 mb near 51°N, 35°W. The AMERICAN ARROW and the BRONISLAW LACHOWICZ in the vicinity of 44°N, 44°W, both had 60-kn winds and waves near 30 ft. The EXPORT LEADER (46°N, 41°W) had the greatest problem with 66-ft swell waves with only 50-kn winds.

On the 12th the first center was 948 mb and the second 954 mb. There was one giant cyclonic circulation that stretched from Nova Scotia to western Russia. There were so many wind reports of over 50 kn and wave reports over 30 ft that it is impractical to list them. The AMERICAN ARROW had the highest of 89-kn winds with 52-ft seas. On the other side of the ocean OWS Romeo fought to stay afloat in 43-ft seas. The CRANIA (43°N, 25°W) had 46-ft waves.

The 37,000-ton West German barge carrier MUNCHEN radioed a distress call at 0325 on the 12th near 46.2°N, 27.5°W. The weather was so bad that several ships passing through the area could not turn to search. Aircraft joined the search to no avail. Liferafts from the vessel were found, but there was no further trace of the vessel or crew. The search was discontinued on the 20th. Also on the 12th at 2209 the salvage tug RODE ZEE reported that the 16,190-ton ORE PRINCE was disabled and drifting about 150 mi southwest of Brest. The tow had parted in the severe weather. Eight fishermen were presumed lost in the sinking of a French trawler off the southwest coast of Britain. The 3,285-ton cargo vessel PLAYAS reported heavy weather damage. The Greek freighter SYROS (5,643 tons) broke her mooring in high winds in Leixoes harbor in Portugal and collided with another vessel.

A large floating drydock broke tow from the Dutch tug TYPHOON and ran aground on the 13th near Pointe De Penmarch in the Bay of Biscay. The German cargo vessel ANTARES requested survey of heavy weather damage which occurred from the 11th to the 19th enroute from Nova Scotia to Dunkirk.

Torrential rains and gales up to 100 mi/h on the night of the 12th killed three British motorists, uprooted trees, and damaged property. The 8,109-ton REGAL SEA reported a man lost overboard off the coast of Brittany.

The gradient started relaxing on the 13th as the second LOW stalled north of Ireland. The maximum winds were in the 50-kn range, but high seas and swell waves persisted. Romeo took the prize with 49-ft seas. The META at 48°N, 06°W, came in second with 48-ft waves. Waves up to 36 ft continued through the 14th. By 1200 the first LOW had dissipated. The second LOW continued to slowly move southeastward into Belgium to finally deteriorate north of the Black Sea on the 17th.

This storm came out of south-central Canada near Lake Winnipeg. As the southern circulation moved over the Gulf Stream on the 17th, it began to intensify. That evening Boston, Mass., measured gusts to 60 mi/h, Worcester had 62 mi/h, and Wallops Island, Va., had 47 mi/h. At Mount Washington Observatory in New Hampshire (6,262 ft) the winds blew at 128 mi/h, increasing to 132 mi/h on the 18th. The average speed was 90 mi/h. The POST CHARGER was off Cape Cod early on the 18th and radioed a wind report of 72 kn. The NANT near 40°N, 69°W, reported winds of about 45 kn and seas building to 28 ft. The ROBERTS BANK was near the U.S. coast and again was slammed by 39-ft swell waves about the time that she encountered the cold front. Later the LASH ITALIA (35°N, 57°W) had 58-kn winds. Boston had 58 mi/h gusts with prevailing winds of 30 to 40 mi/h over southern New England. On the 19th the NANT found 26-ft seas near 40°N, 70°W, and the BARON BELHAVEN, sailing southwestward off the coast, was slapped by 33-ft swells (fig. 50).

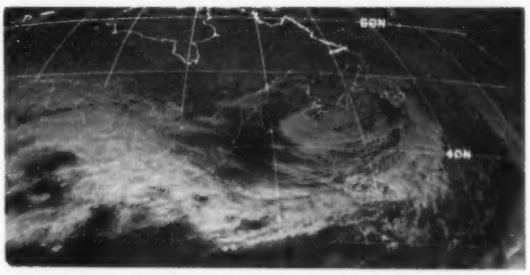



Figure 50. -- The Sun was approaching its winter solstice and the reflection to the satellite is low. The cold air pouring off the land is graphically demonstrated as it crosses the warmer water and clouds form. (NOAA SMS Imagery)

The storm passed over Belle Isle on the 20th and tracked toward the Labrador Sea. This was one of two storms that traveled this primary climatological storm track this month. The STONEPOOL (37°N, 56°W) was far south of the LOW with 50-kn winds, 23-ft seas, and 36-ft swells. The ADM. WM M CALLAGHAN was farther east near 35°N, 51°W, with 40-kn winds and 25-ft waves. At midday on the 21st OWS Charlie was in the tight gradient between the front and a HIGH over Iceland with 40-kn winds and 21-ft seas. On the 22d the LOW was over Foxe Basin headed north into the Arctic Ocean.

This storm came off the eastern slopes of the Rocky Mountains. It was over Ottawa, Canada, on the 21st. Its circulation was influencing shipping off the North American east coast. A ship with the call letters LF3Q reported 56-kn southeasterly winds off Nova Scotia. On the 22d another ship reported winds over 50 kn and swell waves of 30 ft near 40°N, 56°W, in the warm sector. Behind the cold front a SHIP had 50-kn winds with no seas reported. On the 23d and

24th the LOW stalled near 53°N, 52°W. There were gale reports in the westerly winds that connected this LOW with another off the English Channel. It dissipated as the next LOW developed over midocean.

This storm started as a frontal wave on the 23d in the circulation connecting the two LOWs mentioned above. It moved north-northeastward until turning westward on the 24th. By 1200 it was becoming the primary circulation and the NORTHERNSHELL had 56-kn winds near 46°N, 58°W. OWS Lima was in the easterly circulation north of the centers with winds of 47 kn and 23-ft seas. On the 25th it became the primary LOW at 980 mb near 52°N, 28°W. OWS Lima now had 50-kn winds and 30-ft seas. There were 40- to 50-kn easterly winds over the North Sea. Lima now had 50 kn and 30-ft seas. At 1200 the AMERICAN ARROW found 58-kn winds near 42°N, 41°W. The BELLA COOLA near 40°N, 44°W, verified this with a 56-kn report with 36-ft seas added. OWS Romeo was fighting 23-ft seas. Twelve seamen were rescued in the North Sea from the 2,285-ton Swedish freighter ALSTERN. The crew spent 5 hr in liferafts off the east coast of Scotland. The gales also forced a British coaster aground with a crew of eight.

The storm was traveling southwestward on the 26th, while another low-pressure center had formed to the south. This center was to become the storm to contend with on the 27th. At 1200 on the 26th a ship near 38°N, 26°W, had 55-kn northwesterly winds. Thirty-three foot waves pounded the WELCH CITY about 4° latitude to the north. OWS Romeo had 23-ft seas on the 27th, while Lima had 20-ft seas. The POSEIDON (60°N, 18°W) was tossed about by 26-ft seas from the east. These reached Lima on the 28th. This storm disappeared as another approached.

This storm was of Creole origin. It quickly moved over the Atlantic Coast States and passed near Cape Cod on Christmas Day (fig. 51). On the 24th and 25th Wallops Island measured winds over 50 mi/h. The Mount Washington Observatory had 66 mi/h winds and gusts to 149 mi/h on the 25th. Gusts remained over 100 mi/h through the 27th. Providence, R.I., recorded windspeeds up to 50 mi/h. The ARCO PRESTIGE and EXXON JAMESTOWN were both near 39°N, 72°W, with waves to 30 ft. The former reported 45-kn winds, and the latter had 60-kn winds from the west. At 0000 on the 26th the storm was 980 mb near Portland, Maine. The AMERICAN ARCHER (43°N, 65°W) experienced 55-kn winds driving 30-ft seas. The storm relaxed as it moved south of the Maritime Provinces, but it regained its strength later. At 1800 on the 27th, the 970-mb storm was near 47°N, 33°W. The DALESMAN at 40°N, 38°W, was ravaged by 55-kn winds from 290°, 33-ft seas, and 49-ft swells. The EXPORT PATRIOT (40°N, 39°W) found the same winds, but the seas were 44 ft and the swells 33 ft. It was definitely not a pleasure cruise.

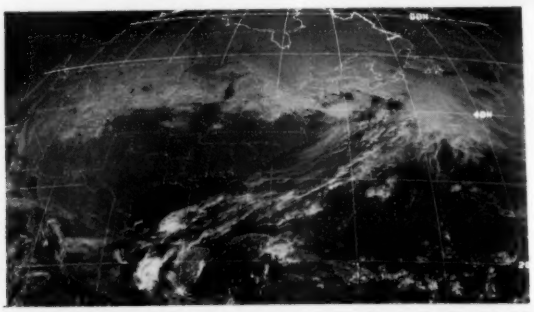


Figure 51.--The United States is nearly evenly divided as far as having a sunny Christmas Day. The storm is off Cape Cod at noon on the 25th bringing high winds to the New England coast. (NOAA SMS Imagery)

On the 28th the winds were generally in the strong gale category. The MINERAL HOBOKEN found 33-ft swells near 43°N, 23°W. Lima measured 50-kn winds and 30-ft seas. The LOW crossed over the United Kingdom on the 29th bringing a severe snowstorm. A band of snow across Scotland blocked roads and stranded hundreds of travelers. To the south heavy rain caused severe flooding. Hundreds were evacuated at York, when the Ouse River reached 16 ft above its normal level. Gales lashed Ireland and Scotland. At Glasgow a fishing boat sank.

In Sweden snow blocked railroads, and the main northbound highway in the south was blocked when three trucks collided. The Baltic Sea froze over earlier than usual. Gales lashed the Normandy and Brittany coasts of France. In Denmark and the Germanies snow snarled traffic. In southern areas of Europe (the Alps southward), the weather was warm with heavy rain in France. Avalanche warnings were posted in the Alps.

Each storm this month was quickly followed by another. This one formed south of Newfoundland at a developing occlusion. It was first located on the 1800 chart of the 27th. The easterly flow north of the storm centers had maintained itself. A ship near 40°N, 59°W, was sailing into 50-kn winds and 26-ft seas at 0000 on the 28th. Other ships to the east were finding 20- to 25-ft seas. On the 29th the EXPORT FREEDOM near 37°N, 56°W, was plowing into 34-ft swell waves. At 1200 and 1800 the sister ship EXPORT PATRIOT at 42°N, 40°W, was pounded by 50-kn winds and 36-ft seas. The DELTA DRECHT (46°N, 33°W) east of the storm had 50-kn southwesterly winds and 33-ft swells. The storm was 970 mb near 49°N, 33°W, at 0000 on the 30th. At midday the EXPORT PATRIOT had traveled 1° longitude in 24 hr and was still being pounded by 36-ft waves. OWS Charlie had 25 ft. By the 31st another center was analyzed to the west, and this one disappeared by the end of the day.

Casualties--The Liberian-registered BURMAH AGATE with 53,000 tons of crude oil was stranded on Southwest Pass on the Mississippi River. Rough weather delayed lightering and refloating. The barge ROBERT L. POLING and the AMY MORAN collided in fog on the 9th in Gravesend Bay near Coney Island. The British cargo vessel GEEST-TIDE (5,871 tons) reported heavy-weather damage on the 14th on voyage to Barbados. The Liberian tanker SEA VALIANT (38,529 tons) lost both bower anchors in rough weather in 18 fathoms of water about 4.5 mi off Leixoes. The C.P. VOYAGEUR reported heavy-weather damage upon arrival at Montreal about the 20th.

The American barge PECK SLIP with 80,000 barrels of oil ran into rough weather near Puerto Rico. High waves damaged the deck piping system with loss of oil. The Greek cargo vessel PANAGHIA THEOSKEPASTI (8,228 tons) was anchored at Gibraltar on the 28th with engine trouble. The current carried her into the Mediterranean, and tug assistance was required.

The Canadian bulkcarrier ALGORAIL was pushed aground by ice in the Detroit River on the 30th. The 3,528-ton Guatemalan-registered LAGO IZABAL reported heavy-weather damage in the Gulf of Mexico.

The 218,665-ton Greek tanker ANDROS PATRIA with 100,000 tons of crude oil was abandoned on the 31st with fire in one of the holds. Three of the crew were rescued, but 34 were missing in heavy seas. The vessel was 24 mi off Cabo Villano. The holds were breached by the heavy seas. Strong gales were pushing an oil slick toward the Spanish coast. The vessel was taken in tow by tugs, and the remaining oil was offloaded.

ROUGH LOG, JANUARY 1979--The storms followed climatology only relatively close this month. The primary path was over the U.S. East Coast to south of Kap Farvel, where the path split with a northern branch into the Labrador Sea and a northeastern branch into the Norwegian Sea. Other primary paths were from south of Iceland toward the English Channel and midocean eastward to the Iberian peninsula. The two are secondary paths according to climatological records. Several low centers stalled near Newfoundland and dissipated as other centers developed.

In contrast the month's mean sea-level pressure had very little resemblance to the climatological mean for the month. The gross climatological mean shows a 1001-mb LOW near 60°N, 35°W; a secondary 1005-mb LOW near 68°N, 00°; and a band of high pressure with several centers along latitude 30°N. This month the Icelandic Low was broken into four centers. The deepest was 1007 mb near the location of the secondary climatological LOW. There were two 1011-mb centers near Kap Farvel and 45°N, 58°W. There was also a 1012-mb center near Cape Wolstenholme. Several cutoff LOWs produced a 1013-mb center near 35°N, 18°W. This month's mean high-pressure band was centered on about latitude 30°N, but the highest pressure of 1019 mb was south of Bermuda.

The largest anomaly center was plus 13 mb centered near 54°N, 32°W. The zero isoline hung like a slack rope from Ireland to Cabot Strait. It dropped to about 37°N at 40°W. There were two negative anomaly centers of importance--a minus 7 mb off the coast of North Africa and a minus 3 mb off Long Island.

The mean upper air pattern at 700 mb over the eastern United States resembled the climatological pattern, except the LOW center was 40 m higher over Foxe Basin. There was a short-wave trough evident southeastward from Cape Race. The climatic ridge normally over western Europe was centered along longitude 30°W this month with a short-wave trough where the ridge normally would be located. As with the sea-level pattern the anomalies were reversed in sign from what normally might be expected. A positive 104 m was near 55°N, 38°W, a minus 71 m was off the coast of North Africa, and a minus 53 m was over Iowa.

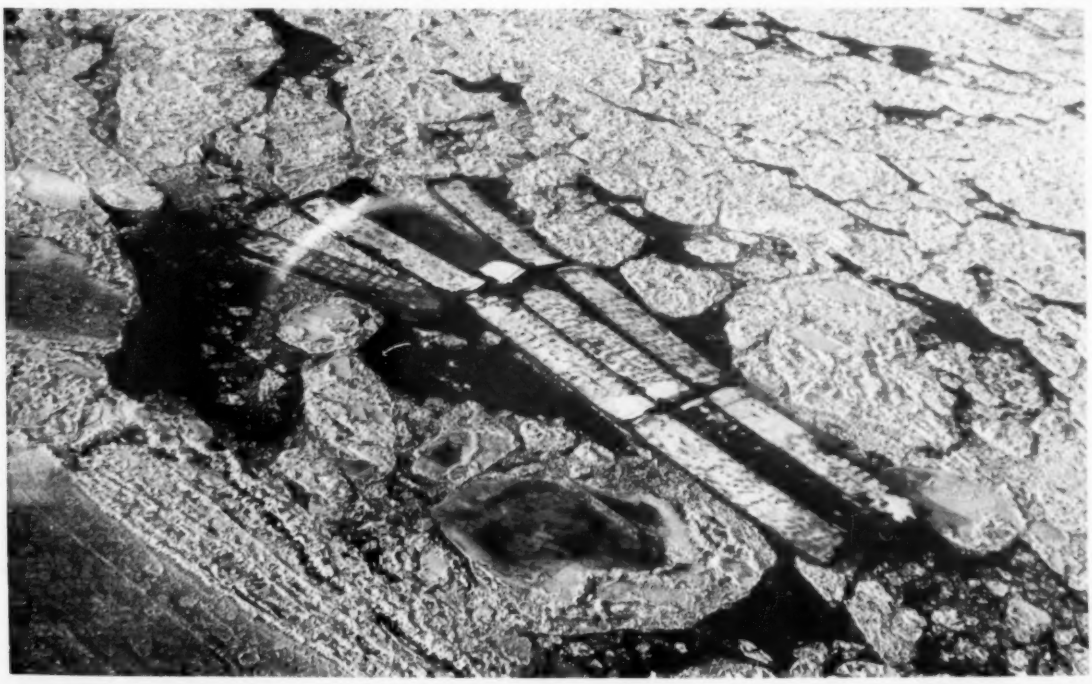


Figure 52.--The 10 empty barges were stuck in the ice near mile 103 on the Mississippi north of Cairo, Ill. U.S. Coast Guard Photo.

Extratropical Cyclones--In general the northern shipping lanes were influenced by high pressure the first 2 weeks of the month. The HIGH built to 1040 mb by the 10th near 40°N, 30°W, before gradually giving way by the 13th. Early in the first week there were two LOWs east and southeast of the high pressure. Other LOWs moved eastward across the top of the HIGH.

Rivers in the Midwest had their problems again this month. There was a 126-mi ice jam on the Mississippi River between St. Louis and Cairo, Ill. (fig. 52). The river was closed to traffic on the 18th and did not reopen until the end of the month. The Coast Guard with commercial towboats and tugs worked to break up the ice jam. This is the third consecutive winter in which severe weather has closed this part of the Mississippi River to traffic. At this time the Ohio River was not severely affected, but it was later in February.

There were deep LOWs over North America and Europe on the 2d. There was high pressure off the U.S. East Coast and the west coast of Europe and North Africa. A LOW formed between the two high pressure centers and moved eastward. At 1200 on the 3d, the 990-mb storm was near 48°N, 14°W (fig. 53). The BRITISH DRAGOON (47°N, 07°W) was pounded by 60-kn winds. At 1800 OWS Romeo measured 48-kn winds with 30-ft seas. The DARINA near 49°N, 06°W, found 50-kn winds and 39-ft swells.

It was reported on the 4th that the storm contributed to 47 deaths across Europe. Only 2.5 in of snow fell in London, but it paralyzed the town. In Manchester 10 in of snow fell, and in Scotland drifts reached 10 ft. A whale in a dolphinarium on a pier in Clacton was rescued when a 60-ft wave nearly destroyed the pier. The cold weather brought ice to many areas. The excursion boat APHRODITE (fig. 54) was damaged by ice pushing her against a pier at the port of Damp in West Germany.

Early on the 4th Romeo was headed into 34-ft seas. At midday the 988-mb center moved inland near Bordeaux. The SUGAR CARRIER near 42°N, 23°W, was sailing northeastward into 25-ft northerly seas. The DARINA was entering the English Channel with 65-kn winds and 35-ft waves. On the 5th Romeo again had

Figure 53.--If this image were from a weather radar scope, the observer may have interpreted the hook as a tornado. (DMSP Imagery)

Figure 54.--Ice coats the side of the excursion boat APHRODITE at the resort port of Damp, Germany. Ice and winds pushed her against the pier which pierced her hull. United Press International Photo.

33-ft waves. Late in the day another LOW formed off Casablanca, and this LOW dissipated.

As the storm moved into Spain and the next LOW formed off Morocco, cold air was pulled over Europe and the Mediterranean from Russia. During the past week Sicily had its first snow in 25 yr. Snowdrifts were 6 ft deep in Sweden. In southern England residents were evacuated from coastal towns. The Adriatic Sea had ice for only the third time in the past 40 yr. Far inland Moscow was having its coldest weather in 100 yr--minus 37°C (-35°F) in the center of the city. By the 7th at least 132 people in western Europe had died from weather-related causes. The Eiffel Tower was ice covered and closed to visitors for the first time in 40 yr. A Spanish freighter sank in the English Channel with only one member of the crew saved.

Monster of the Month--The day after New Year's a front paralleled the North American east coast along the Appalachian Mountains. This LOW developed from one of many frontal waves moving northeastward along the front. The KING COBRA was missing off Atlantic City, where she had reported heavy seas and high winds. On the 3d one LOW north of Sept-Iles dominated the scene (fig. 55). At 1200 on the 4th the 980-mb storm was over the Labrador Sea near 60°N, 56°W. Several Danish ships nearby had winds near 45 kn. At 1800 the PAMIUT (64°N, 54°W) had 63-kn winds. This deep storm continued up the west coast of Greenland, and as often happens another LOW formed near the southeast coast. At 1200 on the 5th this 974-mb storm was over the Denmark Strait. A buoy southwest of Iceland measured 45 kn. The Iceland fishing fleet was hard hit. One boat had 60-kn southeasterly winds off the northwest coast.

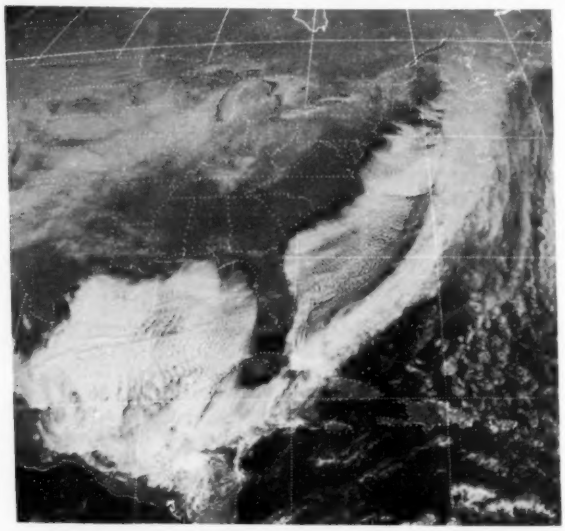


Figure 55.--The center of the LOW cannot be seen because of its northerly latitude and the low winter Sun angle. The front is clearly delineated off the East Coast, and the cold air behind it can be visualized by the cloud streaks formed over the warmer waters of the Gulf Stream and the Gulf of Mexico. (NOAA SMS Imagery)

The cyclonic circulation with this storm covered an enormous area and encompassed several centers. Its circulation reached from Scandinavia to the eastern slopes of the Rocky Mountains and from near the North Pole to latitude 50°N on the 6th. The JOHN CABOT was east of Hopedale with 55-kn winds. Lima had 50-kn winds and 16-ft seas. The NURNBERG EXPRESS found 60-kn winds and 26-ft seas at 1800 near 56°N, 28°W. The KOPALNIA ZOFIOWKA (59°N, 05°E) also had 62-kn winds but reported no seas. On the 7th the GENE TREFETHEN (57°N, 24°W) had 33-ft swell waves on her stern. Lima still had 50-kn winds and 26-ft seas. The many ships and platforms in the North Sea were reporting 45- to 60-kn winds with the seas up to 30 ft.

This LOW was moving into Scandinavia and another had developed south of the Denmark Strait. OWS Charlie was broadcasting 20-ft waves. On the 9th Lima had 58-kn westerly winds and 23-ft seas. The second LOW had disappeared from the analysis. The strong gradient was now over the top of the HIGH rather than near the LOW. A ship had 20-ft seas near 48°N, 23°W. These moved to Lima and Romeo with 40-kn winds at 1200.

The LOW was elongated east-west from Nordkapp to Iceland. On the 10th this broke down into several low centers. One moved eastward from Ireland. Reporters on the North Sea were finding 40- to 60-kn winds with waves of 20 to 30 ft. A ship with the call letters DNCP at 48°N, 12°W, had 20-ft seas and 33-ft swells at 0900 which built to 33 ft and 49 ft, respectively, by 1200. At 1800 they had dropped to 33 ft. Early on the 11th the barge INTERMAC 600 capsized in the North Sea in force 10 winds and 40- to 45-ft seas. On the 12th this last LOW had moved far enough inland that the winds and waves had dropped to reasonable values. The HIGH had peaked at 1040 mb on the 10th and was drifting southeastward with the pressure falling.

This storm formed north of the Gulf of Mexico on the 13th and moved up the Ohio River Valley (fig. 56). It

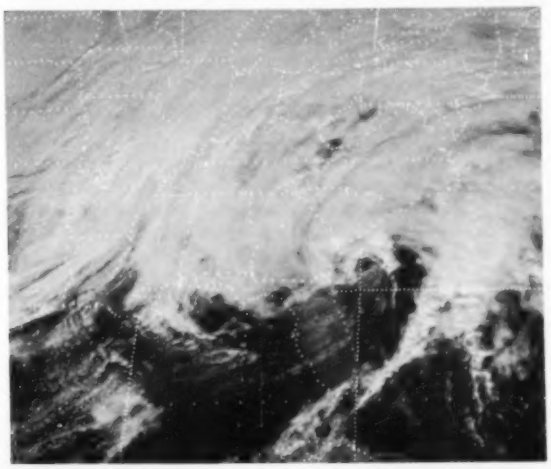


Figure 56.--The center of the primary storm, which is over southern Illinois, is obscured by the high clouds. A small circulation can be seen off the Georgia coast, but it soon disappeared. (NOAA SMS Imagery)

started to influence the eastern seaboard on the 14th with isolated gales. On the 15th the winds increased to 40 to 50 kn as the storm crossed into the Labrador Sea near Goose Bay. At 1800 the LF3Q found 55-kn winds and 16-ft seas near 44°N, 61°W. A ship near 52°N, 42°W, had 45-kn winds and 23-ft seas on the 16th. The LONDON VISCOUNT had 65-kn southerly winds and 26-ft waves near 50°N, 39°W. OWS Charlie was recording winds of 45 to 50 kn and seas around 25 ft. The SHEAF ROYAL (40°N, 57°W) was slapped by 26-ft swells on her port bow. The CHASTINE MAERSK, farther south near 35°N, 54°W, had 39-ft swells pounding her starboard beam. The storm was moving through the Davis Strait on the 17th and split into two centers. One remained stationary east of Cape Chidley for 24 hr, while the northern center moved over Devon Island. The DISKO was caught by a last swipe of 60-kn winds and 23-ft seas off Gothab.

This storm came to life over Missouri on the 17th. It was 998 mb near Sable Island on the 18th. On the 19th (fig. 57) there were several ships that reported winds near 60 kn. They were generally in the southern half of the storm and included the BREEHORN and SUSAK. The H1070 near 46°N, 54°W, had 41-ft swell waves from the northeast.

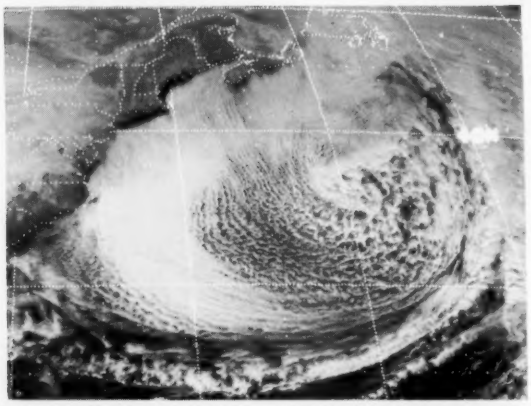


Figure 57.--The surface center of this large storm is obscured near 45°N, 55°W. There appears to be a second center in the upper air near 37°N, 60°W. (NOAA SMS Imagery)

There were reports of waves up to 25 ft on all sides of the storm on the 20th. The winds had decreased to 50 kn and below. On the 21st a secondary LOW formed southeast of Newfoundland as the original LOW died south of Kap Farvel.

This second LOW quickly developed a large circulation as three upper air LOWs consolidated into one over the Azores. Three ships in the southwest quadrant reported waves up to 25 ft on the 22d. One was the USNS YUKON. A French ship radioed 58-kn southeasterly winds near 35°N, 13°W, on the 23d, while the island of Madeira measured 40-kn winds. On the 24th the GANYMEDES had pounding 30-ft swells near 42°N, 17°W. The storm was weakening as it drifted eastward as another storm to the west was winding up.

There was a frontal system paralleling the Gulf Coast on the 20th with frontal waves rippling along it. One of these became a full-blown storm by the 21st and moved northeastward along the Appalachian Mountains. Southerly winds in the eastern hemisphere were already attacking shipping. The 10,343-ton ore carrier UNITED FAITH grounded in 55-kn winds at Cape Fear River, N.C. The MANICA (32°N, 77°W) suffered 55-kn winds and 20-ft waves. Nearby the CAROLINA also reported. The USNS AMERICAN EXPLORER was in the same vicinity (35°N, 74°W) with 30-ft swell waves. About dark on the 23d the MANICA was struck by 70-kn winds and 26-ft seas. Other ships were reporting waves over 20 ft. The storm was 978 mb over Maine on the 22d. The storm split into multiple centers on the 23d which spelled its doom.

The demise of two storms was the beginning of this one. As the last two described storms deteriorated, this one arose to take their place. It was first located on the 1800 analysis of the 23d near 41°N, 45°W. There was already a northwestward and southeastward circulation established south and north of the center associated with the latter two storms. At 1200 on the 24th, the 970-mb center was near 44°N, 48°W. Winds up to 40 kn and seas to 20 ft were established. A French ship, the FNHM (40°N, 47°W), had 50-kn winds with 16-ft seas. The SUSQUEHANNA (35°N, 42°W) was sailing on a collision course with the storm while fighting 33-ft waves. The CRANIA (39°N, 40°W) with a pressure of 986 mb was almost in the direct center of the 985-mb storm with 31-ft southwesterly swells. The storm was moving east-southeastward with generally gale-force winds or less and seas below 20 ft. On the 27th the LOW curved more easterly and ended over Spain on the 28th.

The ancestral history of this storm goes back at least to the 23d. At that time there were three weak low centers alined from the English Channel to the Greenland coast at 77°N. Snowfall of up to 12 in blanketed southern England bringing chaos to roads and railways. Motor organizations reported 500 mi of traffic jams. This large area of general low pressure persisted, expanded, and stretched from Africa to Spitsbergen. This LOW was born in a trough that stretched from the Shetland Islands to Kap Farvel. At 1200 on the 27th it was 980 mb near 60°N, 15°W. The buoy southwest of Iceland was reporting 40-kn winds. On the 28th OWS Lima had snow showers driven by 45-kn winds with 20-ft waves. The ASIA FREIGHTER and the C.P. DISCOVERER were in the vicinity of 52°N, 16°W, with 30- to 33-ft swell waves. The storm was centered over the Irish Sea on the 29th. A ship west of Lands End was sailing into 23-ft waves. The storm disappeared over the continent on the 30th.

This storm tracked along the beautiful white beaches of the Gulf of Mexico until it crossed northern Florida on the 27th. Once over the Gulf Stream, it intensified and moved rapidly northeastward. A U.S. Navy ship near 31°N, 74°W, had 40-kn winds and 20-ft waves. At 1200 on the 29th the storm was 960 mb south of Sable Island (fig. 58). The MAYAGUEZ and another ship not far from 35°N, 73°W, contended with 50-kn winds. These picked up to nearly 60 kn by the 30th. A SHIP near 36°N, 68°W, was buffeted by 20-ft seas and 33-ft swells.

There were many winds of 40 kn or over and waves

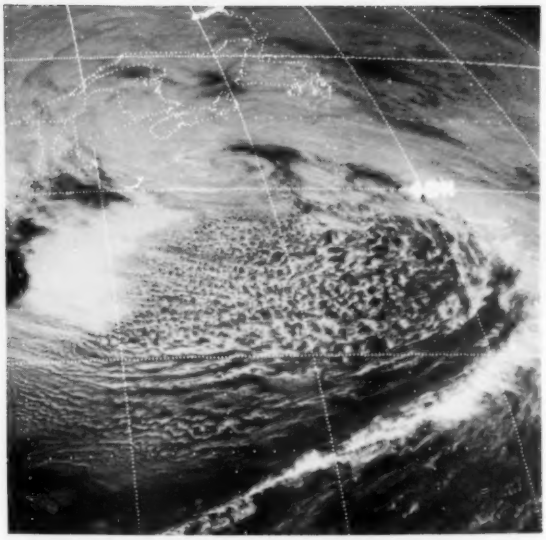


Figure 58.--This storm also favored the area near Sable Island. The instability with high winds and waves is indicated by the cumulus-type clouds west of the front. (NOAA SMS Imagery)

over 25 ft on the 30th. The SHEAF ROYAL (37°N, 67°W) had westerly winds of 64 kn, 59-ft seas, and swells of 49 ft at 1800. Six hours later the winds were 60 kn, but the waves had subsided to 36 ft. By 1200 on the 31st they had decreased to 52 kn and 30 ft. The storm was moving very slowly, and the SHEAF ROYAL was catching up with the center. The LAURENTIC near 32°N, 56°W, was 600 mi south of the 964-mb center with 60-kn westerly winds and 52-ft waves. The CHARLEROI went through the same area ( 32°N, 55°W) 6 hr later, but found only 39-ft waves.

This was the only storm from coast to coast between 20°N and 60°N. Gales were blowing from Cape Hatteras to Cabo Finisterre. A frontal wave came out of the Gulf of Mexico on the 31st and was racing into the storm's center. The 10,984-ton bulkcarrier MITSOS reported leakage and was listing 14 degrees about 1,000 mi southwest of the Azores. The crew of 27 was rescued by the JAMAICA PRODUCER on the 1st. Radar contact was lost and the vessel presumed sunk. At 1200 on February 1 this new storm was 970 mb near 38°N, 63°W. The SHEAF ROYAL was now involved with this system and 26-ft waves. The BALTIMORE TRADER (36°N, 73°W) was sailing homeward into 50-kn winds and 33-ft waves. On the other side of the "pond" the SWEDISH WASA (47°N, 07°W) contended with 45-kn winds from the southwest, 30-ft seas, and 33-ft swells on her bow.

On the 2d the AQUILON, CHARLEROI, and SUGELA reported 65-kn winds, and the VATUTINO had waves up to 36 ft in the area from 30° to 36°N and 55° to 70°W. At 1200 there were two swell wave code 40 (66 ft) height reports from the CHARLEROI and the EXPORT CHAMPION. On the 3d the CHARLEROI had 56-ft waves near 31°N, 58°W, and the KIMITSUSAN (34°N, 54°W) had 61-ft waves. The storm was now 954 mb at 45°N, 45°W. Two ships reported 49-ft waves on the 4th--the ESCHERSHEIM (31°N, 52°W) and the GZON (34°N, 38°W). At 1200 the AQUILON (34°N, 40°W) radioed 80-kn winds just prior to passage of a trough.

On the 5th the EXPORT CHAMPION (38°N, 58°W) found 33-ft swells about 900 mi southwest of the 960-mb center. On the 5th and 6th the LOW began tracking westward. There were still strong winds and high waves. The OIHZ (38°N, 65°W) found 70-kn winds, and the SALLAND (36°N, 57°W) now was the one with 49-ft waves plus 60-kn winds. At 1200 on the 6th, the low center had retrograded to Newfoundland, and a new center formed in the circulation to the south. By 0600 on the 7th the older center had disappeared, and the new one was the storm of the hour.

Casualties--The 272-ft rig tender S.T. 95 with 28 people on board was foundering in gale-force winds and 18-ft seas about 80 mi southeast of Cameron, La., on the 2d. Pumps were airlifted and the situation brought under control. On the same day the 5,588-ton tanker MASTER MICHAEL caught fire in the Caribbean Sea. Thirty crewmen who abandoned ship did not survive, but four of five that remained aboard survived. They were picked up by the passing Italian freighter ILICI. One man drowned while the men were swimming to the rescue ship.

The 13,804-ton French cruise ship MERMOZ was struck by high winds while entering Miami on the 4th. The vessel listed 12 to 14 degrees. On the 8th it was reported that two barges, the OCEAN STATE and the SEA STAR, were cut from their tugs during bad weather off Cuba. The WILSTAR (132,000 tons) limped back to Tunisia after an 8-m crack was discovered in its deck. It was thought that bad weather after sailing from Tunisia may have been involved.

The 15,600-ton bulkcarrier OGDEN IMPORTER arrived Holyhead, United Kingdom, on the 6th with heavy weather damage that occurred on December 27 to 29 and January 3 to 5. The 18,995-ton bulkcarrier CAPTAIN DEMOSTHENES struck the quay at Funchal in high gales and suffered indents. The wind swept three 30-ft containers into the sea and damaged six others. The 10,688-ton ROTHESAY CARRIER reported water damage to cargo in force 8 to 10 winds during the 3 days prior to arrival in Miami on the 25th.

The MARJORIE LYKES (8,762 tons) sustained surging damage on the 13th and 14th at Casablanca. The bulkcarrier GEMINI (15,287 tons) sustained ice damage on Lake Michigan about the 28th. The supply vessel OCEANUS sank in the Gulf of Mexico due to cargo shifting in heavy weather on the 31st. The 44,875-ton tanker KITTANNING was surveyed at Delaware Bay for heavy-weather damages that occured on the 31st and February 1.

# Rough Log, North Pacific Weather

## December 1978 and January 1979

ROUGH LOG, DECEMBER 1978--There are normally three primary storm tracks across the North Pacific in December. This month there were two. The westernmost one, which reached from Hokkaido to the eastern shore of Kamchatka, matched climatology. The second track partially matched climatology. It extended from east of Honshu northeastward into the eastern Bering Sea, crossing the Aleutians near 175°E. There were individual storms over the eastern ocean that traveled in all directions with no primary path.

The Aleutian Low was 995 mb near 57°N, 176°E. This compares with a climatology of two LOWs of about 1001 mb, one in the Gulf of Alaska and the other near the Near Islands. The Pacific High was 1025 mb near 41°N, 138°W. The climatic 1020-mb High is near 30°N, 130°W. A climatic 1020-mb High over the Great Basin was 1025 mb.

The most significant anomaly was plus 14 mb centered near 49°N, 140°W. This in part explains the absence of the primary climatological storm track from the central ocean to Vancouver Island. The single Aleutian low center produced a negative 12-mb center near Saint Lawrence Island in the Bering Sea.

The upper air pattern at 700 mb more closely resembled climatology than at the surface. The low center over Siberia was 90 m lower at 2635 m than its climatic counterpart. The main difference in pattern was that the ridge normally over the Rocky Mountains was farther west off the coast.

There were no tropical cyclones this month.

Extratropical Cyclones--When this storm crossed into the Sea of Okhotsk on the 2d, it already had a good circulation. On the 3d four Japanese ships reported winds of around 50 kn between latitudes 40° and 50°N and longitudes 150° to 170°E. The highest waves were 23 ft. The PRESIDENT JEFFERSON (48°N, 160°E) found 50-kn winds. A ship that appeared to be the BRAZILIAN HOPE (51°N, 169°E) was slapped by 30-ft swells. At this time (0000) the LOW was 972 mb near 58°N, 175°E. St. Paul Island had gusts to 69 mi/h. On the 5th the LEO was near the Rat Islands and found 65-kn winds. By the 6th the LOW disappeared over the Arctic ice.

The next storm formed on the western shore of the Sea of Japan. It crossed over Hokkaido on the 5th and by 1200 was a 962-mb maelstrom near 50°N, 157°E. The GLADIOLUS was near 36°N, 145°E, behind the cold front, with 60-kn winds. The PRESIDENT JEFFERSON was now near 45°N, 153°E, with 70-kn hurricane-force winds and 26-ft waves. The ASIA ZEBRA at 48°N, 156°E, was within 100 mi of the center calling the winds 97 kn from 210°. The seas were 30 ft and the swells 46 ft from 180°. The island of Ostrov Urup measured 50-kn winds. The LOW was moving along the Kurile Islands. At 0000 on the 6th the PINE LIGHT was near 47°N, 161°E, nearly due south of the storm's center. She reported 55-kn westerly winds, 23-ft seas, and fantastic 66-ft swells (fig. 59). Her swell code seems high, but all observations appeared good--who can outguess the sea. The closest comparable sea or swell reported was 30 ft. On the 6th and 7th there were several reports of waves over 20 ft, but by 1200 on the 7th the LOW was gone.

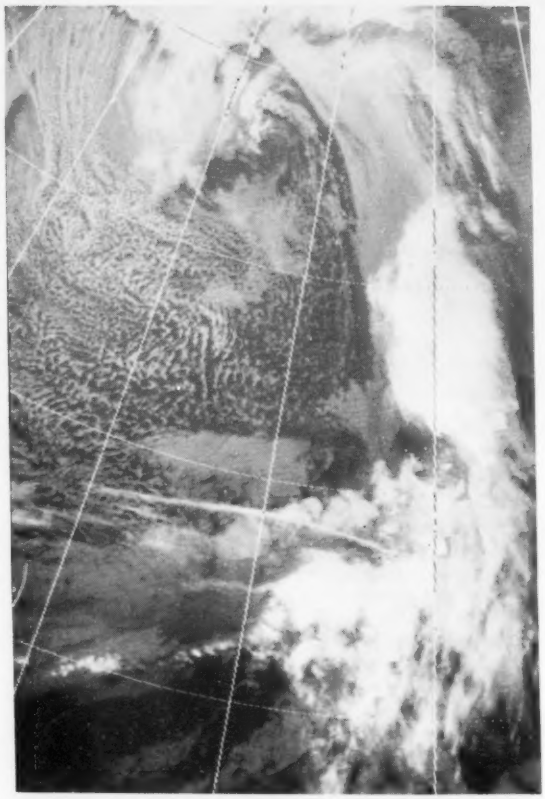


Figure 59.--On the 6th the LOW has moved to near 56°N, 163°E, off the Kamchatka peninsula. Note the cold air pouring out of Siberia. (DMSP Imagery)

This LOW broke away from an older one that was moving northward on the west coast of the Kamchatka Peninsula on the 11th. The MAMMOTH FIR was ahead of the storm near 50°N, 173°W, with 50-kn winds and 16-ft waves. By 1200 on the 12th the storm was 966 mb at 56°N, 168°W. There were not many ship reports, but there were a few reports of winds between 40 and 50 kn. The GLADIOLUS was one ship that reported near 48°N, 152°W, with 62-kn winds from the southwest. On the 13th the SHUKO MARU was tossed by 33-ft seas, and the EASTERN FUJI braved 58-kn winds (fig. 60). The EXXON PHILADELPHIA was battered by 60-kn winds and 46-ft swell waves on the 14th near 58°N, 143°W. The 15th found the MOBIL MERIDIAN (57°N, 140°W) with 41-ft swells. The KASUGAI

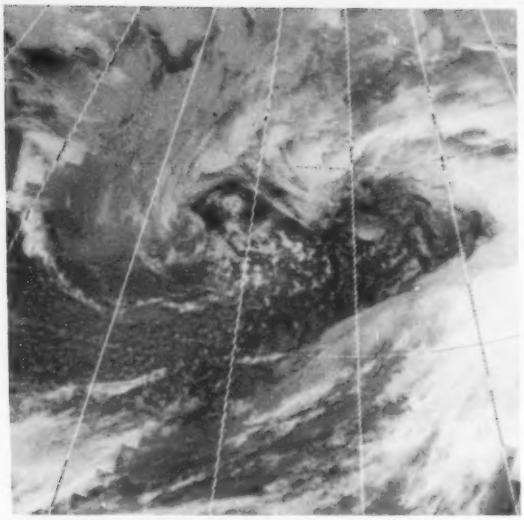


Figure 60. -- The storm is over the cold Bering Sea. Note what looks like a gigantic thunderstorm roll cloud near 56°N, 167°W. (DMSP Imagery)

MARU near 50°N, 129°W, contended with 64-kn winds from the northwest, and the ARCO PRUDHOE BAY at 55°N, 136°W, fought 34-ft waves. The LOW became stationary on the 15th and was absorbed by another system on the 16th.

For about a week the ocean was cut up by many LOWs and several HIGHs. None developed very much, so large ships were not threatened. On the 20th the area between 30°N and the Bering Strait supported six LOWs and three HIGHs. That day a LOW developed near 36°N, 152°E. It tracked northeastward, deepening as it moved. By 0000 of the 22d the LOW was 964 mb near 56°N, 177°E. Although the storm was very deep, it was not producing winds much above gale force at this time. Cold Bay, Alaska, measured 52 mi/h winds as did St. Paul Island, where winds gusted to 63 mi/h.

At 0000 on the 23d the KASUGAI MARU found 56-kn westerly winds, 36-ft seas, and 39-ft swells near 54°N, 169°W. Later in the day the storm dominated the area north of latitude 45°N. Several ships in the Gulf of Alaska reported waves near 25 ft on the 24th. The storm was now over the Yukon River where it dissipated rapidly.

Kyushu was the birthplace of this storm on the 22d. The storm moved along the south coast of Japan. The first high winds were reported by fishing boats on the 23d east of Hokkaido. There were three reports near 50 kn with the highest 56 kn. The storm deepened rapidly as it moved over the warm waters east of Japan, and high wind reports increased with larger waves. On the 24th the 9VPV had 60-kn winds near 35°N, 144°E. There were several other reports near 60 kn. The NEDLLOYD FUKUOKA was 5° longitude to the east with 38-ft seas and swells driven by 56-kn winds.

The storm was 972 mb near 43°N, 163°E, early on the 25th (fig. 61). The ALSTER EXPRESS appeared

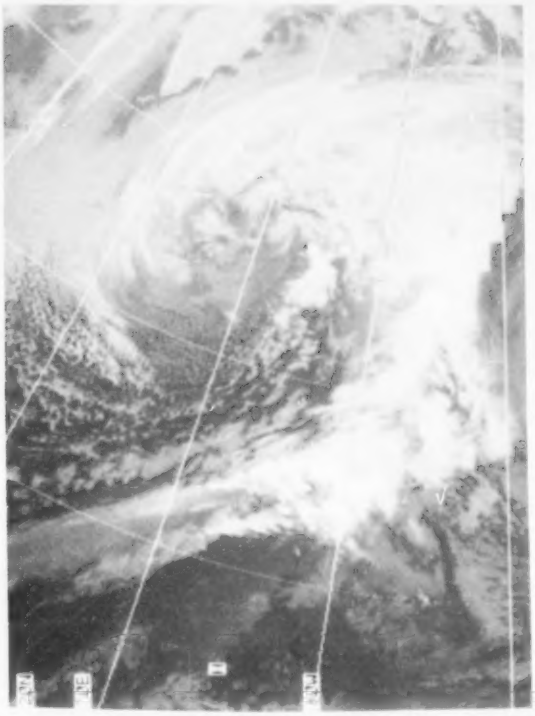


Figure 61. -- Later in the day the storm has moved to the vicinity of 47°N, 166°E. (DMSP Imagery)

to have found the worst weather. She was at 38°N, 164.5°E, with 60-kn winds from the west-southwest, 33-ft seas, and 49-ft swells. Other ships were also suffering waves over 30 ft. As usual in the Pacific there are quite a few reports at 0000 but few at the other synoptic hours. The KASUGAI MARU is a very good reporter, and on the 26th her winds were 58 kn with 26-ft waves. The waves increased to 36 ft on the 0600 observation. The SEA-LAND MCLEAN at 37°N, 179°E, was 800 mi south of the center and sailing with 50-kn winds and 33-ft waves on her stern. There was a large area from 300 mi west to 1,000 mi south of the storm's center where nearly all the waves were at least up to 25 ft and many over. Of the five ships that reported under the influence of the storm at 1200, three had waves over 25 ft.

The 0000 chart of the 28th showed a SHIP near 47°N, 174°E, with 39-ft swells. The SEALAND FINANCE was near 42°N, 178°W, at 1200 with 20- to 25-ft waves. A small LOW developed on the periphery of the storm on the 28th, and it became the primary storm late on the 29th.

The Sea of Japan produced this storm. It moved across Hokkaido on the 27th and, as expected, intensified. A ship at 35°N, 147°E, had 50-kn winds from the south and 30-ft swells. Another LOW had developed south of Kyushu on the 27th and was following a parallel track about 600 mi to the south. There were three reports of winds of 50 kn or greater and a 25-ft wave report with this storm.

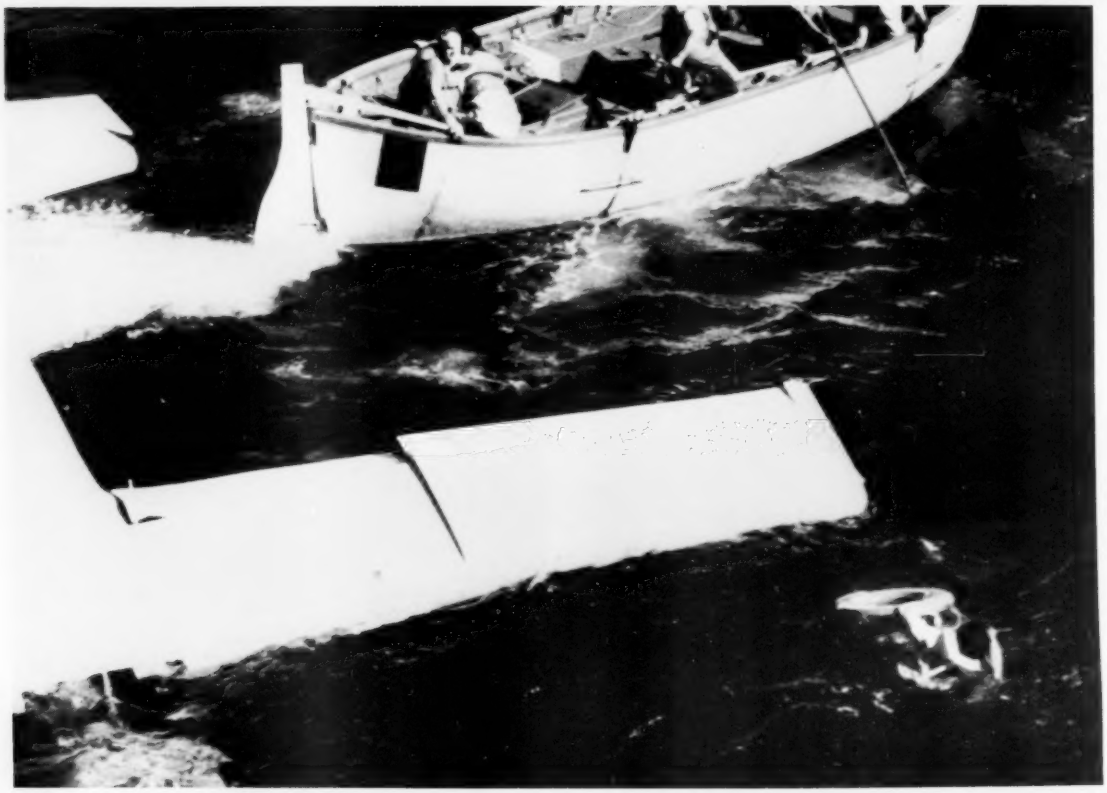


Figure 62.--The pilot of the Cessna 182 clings to his lifering beside the aircraft as a lifeboat from the MANULANI moves in to pick him up. Wide World Photo.

On the 29th the original LOW absorbed both circulations. The JJAD (36°N, 160°E) fought 50-kn winds, 26-ft seas, and 43-ft swells as much as 40° off the wind. The VAN ENTERPRISE (44°N, 165°E) had southerly 68-kn winds within a few mb of the center. At 0000 on the 30th the storm's pressure had dropped to 941 mb. The island of Ostrov Beringa broadcast a pressure of 941.8 mb. This corresponds to 27.81 in of mercury or an elevation of about 2,000 ft in the standard atmosphere. The SHOZUI MARU had a pressure of 951 mb at 0300 near 52°N, 169°E. Her winds were 68 kn and waves 39 ft. Several other ships had winds near 60 kn and waves over 30 ft.

In the meantime a peripheral LOW had formed off northern Honshu and it was moving around the outer circulation. On the 31st it turned northwestward and by January 1 was the only circulation. The central pressure had risen to 958 mb. A ship near 47°N, 175°E, had 33-ft seas and 39-ft swells. On the 1st, the maximum winds were near 50 kn and waves 25 ft. This LOW dominated the area from latitudes 30° to 70°N and longitudes 140°E to 150°W. The storm was now stalled near 57°N, 167°E, and filling. On the 3d it started moving eastward again, but early on the 4th it dissappeared.

Casualties--The 90-ft American research vessel HOLO HOLO was declared missing on the 11th off Hawaii with 10 people aboard. The Indian bulkcarrier CHENNAI SADHAHAI bound from Vancouver to Osaka reported heavy-weather damage. The Singapore-registered KEYAKI (18,707 tons) bulkcarrier reported weather damage on the 11th, and the Panamanian cargo vessel NEW SOUTH SEAS had heavy-weather damage on the 18th.

The pilot of a Cessna 182 that developed fuel problems while being ferried to Honolulu on the 6th ditched the aircraft near the containership MANULANI (fig. 62) about 240 mi northeast of Honolulu. The pilot was rescued by the ship's crew.

The 9,110-ton American JOHN TYLER reported heavy-weather damage on the 29th. The Singapore NEPTUNE EMERALD reported damage to the gangway by weather.

ROUGH LOG, JANUARY 1979--Few storms penetrated the west coast of North America this month, as high pressure diverted them northward before they reached the coast. The primary track was generally eastward from Japan to midocean, where it abruptly turned northward into the Bering Sea. A second path was northeastward along the Kurile Islands. Late in the month a few storms entered the Gulf of Alaska, as high pressure over Alaska broke down. Frontal systems penetrated to the West Coast, but associated cen-

ters tended to dissipate over the water.

This month's mean sea-level pressure pattern over the North Pacific matched the climatic pattern much better than it did in the North Atlantic. The major feature was the 989-mb Aleutian Low at 54°N, 174°E, which was relatively close to its 999-mb climatic position of 50°N, 170°E. Another significant feature was a 1029-mb High centered over the Canadian Rocky Mountains. There is normally a 1021-mb High in the area farther south near the Great Salt Lake. The high-pressure ridge over the southern part of this ocean was normal in location and pressure.

The prominent anomaly centers were associated with the pressure centers mentioned above. There was a minus 14-mb center near 60°N, 180°, and a plus 10-mb center near Edmonton, Canada. There was also a minus 9-mb center over the northwest shore of the Sea of Okhotsk.

In the upper air at 700 mb the low center was shifted eastward from the climatic position, resulting in a 103-m anomaly over the central Bering Sea. The normal ridge over the North American west coast was shifted westward off the coast and sharper than usual. This resulted in positive anomalies over western Canada and Alaska.

There was one tropical cyclone over the western ocean, typhoon Alice.

Extratropical Cyclones -- High pressure moved over the Gulf of Alaska, Alaska, and western Canada on Christmas Day. This HIGH and ridge basically paralleled the coast and fluctuated in the area until January 10, when the cell over western Canada rapidly dropped southeastward. This block reached its maximum pressure of 1060 mb on the 3d. Lows over the central ocean moved against the HIGH and dissipated.

This LOW formed as a frontal wave on the 3d on a front that developed from a trough over midocean. It was 988 mb near 37°N, 178°W, at 1200 on the 3d. By 0000 on the 4th it was 966 mb near 41°N, 170°W (fig. 63). This was a fall of almost 2 mb per hr. The OCEAN DUKE with a pressure of 969.5 mb was very near the center with 50-kn winds and 28-ft seas. Other ships were receiving gales in the 40-kn range. The storm slowly drifted northward and at 1200 on the 5th was 980 mb near 50°N, 170°W. The ALASKA STANDARD was south of Shelikof Strait with 40-kn northeasterly winds and 36-ft swells. A LOW had formed off the California coast, but it only survived about 36 hr. On the 6th the LEO (46°N, 177°W) reported winds of 64 kn. The LOW was drifting southeastward on the 6th and was absorbed by an approaching LOW on the 7th.

This storm penetrated a little farther into the HIGH than the previous one, but it had a longer run at it. At 0000 on the 6th the 998-mb circulation was near 35°N, 165°E. The SANTA BARBARA MARU (38°N, 161°E) discovered 57-kn northerly winds. By 1200 on the 7th the ALASKA STANDARD was near Montague Island with 78-kn southeasterly winds. This LOW absorbed the previous LOW and was a large circulation. On the 9th the storm was 958 mb near 44°N, 153°W. This was as far east as the low center penetrated. The CHESTNUT HILL (45°N, 145°W) encountered 45-kn winds and 20-ft waves. OWS Papa also measured 45-kn southeasterly winds with 25-ft waves. On the 10th the PHILADELPHIA (56°N, 141°W) was sailing into relatively mild 40-kn winds, but her swell waves were 30 ft. North of the Aleutians near the date line the KASHIMA MARU had 56-kn winds from the north. On the 11th the storm was deteriorating rapidly. It dissipated on the 12th.

A large 1058-mb cold HIGH was centered near Lake Baykal on the 10th. It was pouring extremely cold air--as low as -50°C--into Manchuria. A front lay east-west across Korea and Japan, and a wave formed

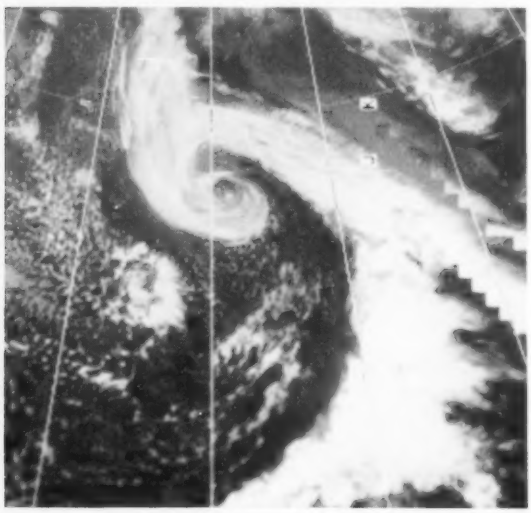


Figure 63. -- Later in the day the storm had moved northward to about 47°N, 169°W. (DMSP Imagery)

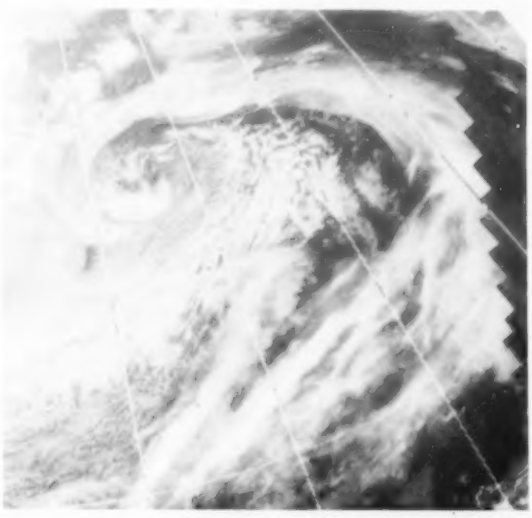


Figure 64.--This infrared depiction locates the storm near Ostrov Beringa. (DMSP Imagery)

over the Sea of Japan. The storm raced northeastward under strong flow aloft. By 0000 of the 11th it was 968 mb near 48°N, 159°E. A SHIP near the center with 974-mb pressure had 65-kn winds and 21-ft seas. The QUEENS WAY BRIDGE (48°N, 160°E) and the WORLD SUPREME (40°N, 148°E) both found 30-ft seas.

By 0000 on the 12th, the storm was 952 mb at 55°N, 167°E (fig. 64). It was generating some very severe weather. Two ships were especially hard hit. The HARFLEUR (53°N, 169°E) (959 mb) was ravaged by 71-kn southwesterly winds, 46-ft seas, and 54-ft swells; and not far away the D5GO (51°N, 169°E) (977 mb) had to stay afloat in 57-kn winds, 33-ft seas, and 39-ft swells.

The HARFLEUR was moving eastward while the storm was traveling northward, but she still had 43-ft waves and winds of 50 kn. The ASIA HUNTER was west of Umnak Island with 50-kn southerly winds. Early on the 14th a ship near 49°N, 166°E, had 30-ft swells. A frontal wave was moving northeastward around the storm's outer circulation and weakening the gradient, so there was no longer any heavy weather.

This surface LOW formed in response to an already-formed upper air LOW near 42°N, 160°W, on the 11th. It moved northeastward and at 0000 on the 13th was 990 mb near 47°N, 147°W. A ship near 42°N, 142°W, had 31-ft swell waves. Late on the 13th a second center formed southeast of this one. Another ship near 38°N, 139°W, had 52-kn winds and 33-ft waves on the 14th. Later in the day the second LOW absorbed the first and was 980 mb near 44°N, 131°W. What was probably the same ship had 65-kn winds and 34-ft waves at 1200.

This storm was making a brave attempt to break through the ridge and penetrate the California coast. The LOW covered the shipping lanes from California to Hawaii, and several ships recorded winds over 40 kn. In the southwest quadrant the ROBERTS BANK (34°N, 137°W) and the WESTOCEAN (36°N, 141°W) had 50-kn winds with 26- and 31-ft waves, respectively. The center pushed almost to the northern California coast, but it had split into two weak centers on the analysis of the 16th.

For many days there had been a quasi-permanent LOW east of the Kamchatka peninsula. Several LOWs had rotated around the periphery toward the Bering Sea. Fort Randall measured 50-kn winds on the 15th with the passage of one of these storms. It was about this time that a frontal wave developed east of Tokyo. It raced eastward at over 50 kn producing gales. On the 16th it moved deeper into the parent circulation of the LOW over the Bering Strait. As it entered the Gulf of Alaska on the 17th, it started to deepen and was 972 mb near 55°N, 148°W, at 0000 on the 18th. Three ships reported swell waves from 36 to 41 ft. They were the OJI GLORIA (53°N, 143°W), the VAN ENTERPRISE (46°N, 142°W), and a SHIP (53°N, 137°W). The CHEVRON OREGON and VAN ENTERPRISE both reported 74-kn winds. On the 19th two ships had 26-ft swell waves near 53°N and south of the storm's center. The storm moved ashore at midday and disappeared.

This LOW almost exploded into a full-blown storm.

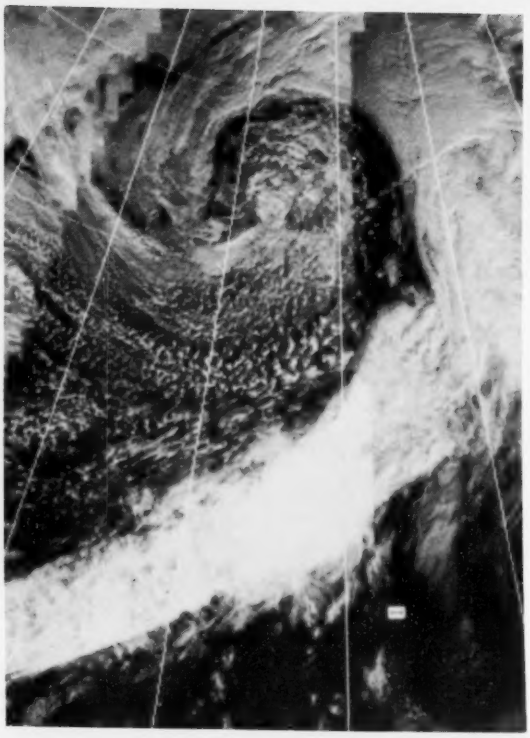


Figure 65.--The deep center was near 54°N, 177°W, as the satellite viewed the storm. With some concentration and a lot of imagination, the head and shoulders of a person can be visualized. (DMSP Imagery)

Within 18 hr after it was first analyzed it was sporting 60-kn winds 400 mi south of the center. At 1200 on the 18th it was 981 mb near 38°N, 147°E. An English ship 200 mi from the center had 26-ft waves. Gales were blowing in all quadrants on the 19th. The CHIKUZEN MARU (39°N, 156°E) reported 70-kn westerly winds. Two ships had 33-ft waves. By 0000 on the 20th the storm was 952 mb near 50°N, 170°E. The SANKOGRAIN had 60-kn winds southwest of the center. The EURYALUS (47°N, 159°W) suffered 46-ft waves with 55-kn winds. The islands of Saint Paul, Adak, and Unimak all measured at least 40-kn winds.

The storm reached its lowest pressure of 944 mb on the 21st (fig. 65). It appeared that the storm had chased many ships either into port or to the south as reports were few even at 0000. The highest wind reported was 50 kn on the edge of the storm. With the tight gradient there should been stronger winds closer to the center. By the 22d the storm was filling, but the VAN ENTERPRISE (45°N, 167°W) had 65-kn winds and 30-ft waves. The storm moved slowly through the Bering Strait and disappeared on the 25th.

This LOW came out of the same area as the previous one but was a slow learner. It moved eastward across the Tsugaru Strait. Two ships found high swell

waves, which were probably associated with the previous storm. The ZENLIN GLORY near 36°N, 160°E, found 30-ft waves south of the LOW, where the winds had not changed their westerly orientation from the previous storm. The LOW was centered near 46°N, 176°E, at 994 mb at 0000 of the 23d. The VAN ENTERPRISE measured 34-ft swells with 83-kn winds about 550 mi southeast of the storm's center. At 1200 the PRESIDENT MADISON (45°N, 175°W) had 40-kn gales. On the 24th the VAN ENTERPRISE had sailed about 150 mi in 24 hr. Her winds had decreased to 47 kn, but the swells were still 36 ft. At 1200 the SEA-LAND TRADE (47°N, 159°W) was sailing with 31-ft swells. On the 26th the weakening storm passed south of Kodiak Island and then inland.

On the 24th the ocean north of latitude 25°N was cut up by eight low centers and three high centers of various sizes. On the 0000 chart of the 25th a low-pressure center was analyzed on a cold front near 34°N, 173°E, with the aid of observations from the IRIS ISLAND and 9VUP. West of the LOW, but only connected to it by the general circulation, the BENNY SKOU was caught by 34-ft swells.

The frontal wave rolled northward up the front and absorbed three small low centers and one high center. The tightly wound storm was 961 mb near 45°N, 178°W, at 0000 on the 26th (fig. 66). The MUSA was within a few miles of the center with a barometric pressure of 966 mb, 40-kn southerly winds, and easterly 30-ft swells. An unidentified ship 240 mi to the southeast was sailing with 30-ft swells from the south-southwest. The SHUKO MARU took the award though with 49-ft swells from the northeast while about 700 mi northwest of the storm. At 0600 two ships reported 60-kn winds with one having 30-ft seas. By 1200 the storm had consumed another small center.

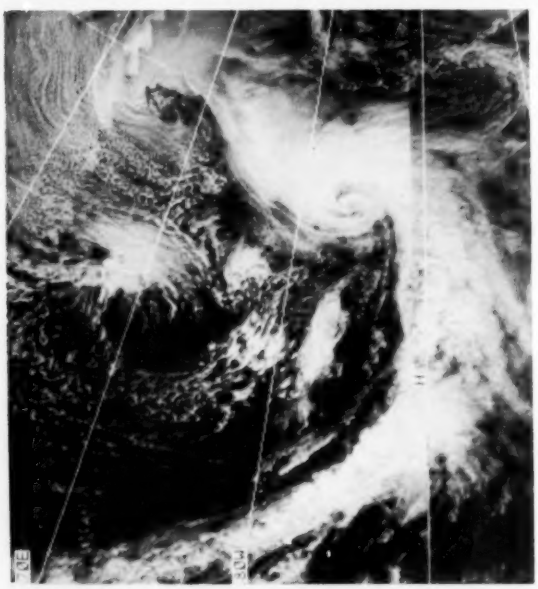


Figure 66.--The primary low center is in the vicinity of 46°N, 175°W. There appears to be a developing frontal wave near 38°N, 168°E. (DMSP Imagery)

The BENNY SKOU was sailing eastward as the storm moved northward, but this did not prevent her having 34-ft swells on the 27th. Two other ships in the southeast quadrant had 30-ft swells. By midday on the 28th the storm was gone.

As usual, this storm was born as a frontal wave. This time northeast of Tokyo on the 25th. It moved eastward as the last storm moved northward. By 0000 on the 27th the LOW was 982 mb near 35°N, 162°E. The LOW had crossed slightly north of the westerly track of the KOREAN PRIDE. At this time she had 50-kn winds from the northwest, 26-ft seas, and 30-ft swells. The SEA-LAND COMMERCE must have been within a few millibars of the center as at 0600 she was due west of the center with 80-kn northerly winds, 33-ft seas, and 41-ft swells. At least three other ships reported waves to 25 ft.

High pressure was protecting the U.S. West Coast by diverting the storms northward as they approached 180°. That is what happened to this one on the 28th. On the 29th it turned westward and on the 30th swallowed another LOW that was following it. At 1200 the large storm was only 993 mb near 53°N, 172°E, with a loose gradient and light winds. A ship far to the south near 32°N had 26-ft swell waves. The storm was assimilated into another that formed on the associated front on the 31st.

This was a vicious, short-lived small storm that seemed to appear out of nowhere and disappeared in the same way. It was the one the previous storm absorbed on the 30th. A 10-kn easterly wind report of the VAN ENTERPRISE at 0000 on the 28th was the tip off that this LOW had formed. The STREAM DOLPHIN (29°N, 163°E) was pounding into 29-ft swells from the northwest on her westerly course. Another hint of the storm was the increased winds south and west of the center. By 1200 the LOW was 976 mb. The LIONS GATE BRIDGE (40°N, 164°E) was about 1° latitude to the south of the center with 65-kn winds. The SILVERMAIN 400 mi to the south was sailing into 55-kn westerly winds and 26-ft waves. On the 29th two ships radioed winds of 50 kn. The PRESIDENT VAN BUREN was far south (30°N, 163°E) with 33-ft swell waves from the west. At 0600 the PRESIDENT JOHNSON was nearly overwhelmed by 56-kn southwesterly winds, 30-ft seas, and 46-ft swells. On the 30th the storm moved close to the previously described storm and was absorbed.

The Pacific High was firmly entrenched in the vicinity of 40°N, 150°W, on the 31st. In the previous days, several fronts had piled up on its west side and dissipated. On the 30th another paralleled 170°W, and on the 31st a wave formed near 40°N, 173°W. By February 1 it had absorbed an older LOW to the northwest and was 982 mb near 47°N, 170°W. A ship near 46°N, 165°W, had 48-kn winds. Another on the opposite side of the LOW (173°W) had 40-kn winds and 20-ft seas. On the 2d the storm crossed into the Bering Sea near Atka Island. The CANADA MARU and TAIKAI MARU were near 53°N, 179°W, with winds of plus 40 kn, but their real problem was 33-ft swells. At 0600 the PRESIDENT MADISON was in the same vicinity with 28-ft waves. On the 3d the storm stalled near 50°N,

165°W, and no longer existed on the 4th.

A wave formed on a front that finally managed to penetrate the northern part of the Pacific High on the 29th off Seattle. It moved southward with little affect on shipping along the coast. There were several isolated reports of 40-kn gales. It was on the 31st in the Los Angeles area that the LOW made its reputation. On the night of the 30th it drenched Long Beach with nearly 4 in of rain (fig. 67). Before it was over, they had almost 5 in. On the 31st thunderstorms were occurring along the coast and 1.5 in of hail fell south of Los Angeles at Torrance. A waterspout was sighted west of Los Angeles airport. A possible tornado caused millions of dollars damage to Universal Studios. In higher elevations there was heavy snow. On February 1 the storm moved inland and dissipated.

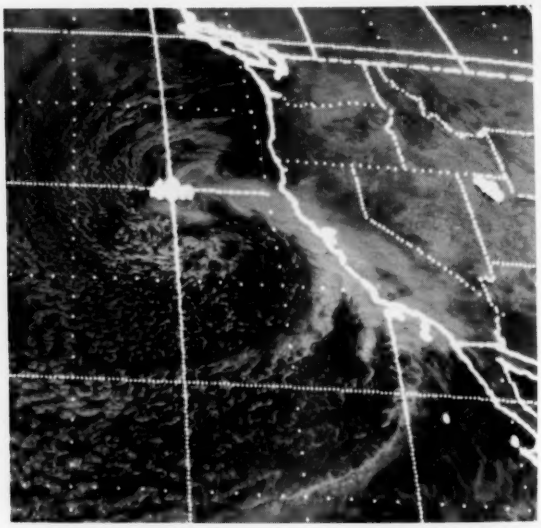


Figure 67.--At 2045 on the 30th, the storm was centered off northern California with the heavy clouds extending down the coast, bringing heavy rain, thunderstorms, and all that goes with them. (NOAA SMS Imagery)

Tropical Cyclones--January tropical cyclones occur about once every 2 yr. Typhoons are even less common, and one of Alice's intensity is rare. They are usually low-latitude storms, and Alice conformed to this rule. She developed nearly 300 mi south of Kwajalein on New Year's Day. After moving northward for a few days, she turned westward near Kwajalein. Alice reached typhoon strength on the 6th shortly after passing Eniwetok. On the 7th (fig. 68) winds near her center were roaring at 100 kn, an intensity she maintained until the 9th. Alice was a compact typhoon, and her strong winds were confined to within about 15 mi of her center. Peak winds were estimated at about 110 kn with gusts to 135 kn on the 8th. Alice passed about 100 mi south of Guam on the 9th. Two days later she slowed and began to recurve northward. By the 12th she started to undergo severe vertical wind shear. This process caused her to weaken rapidly. Winds

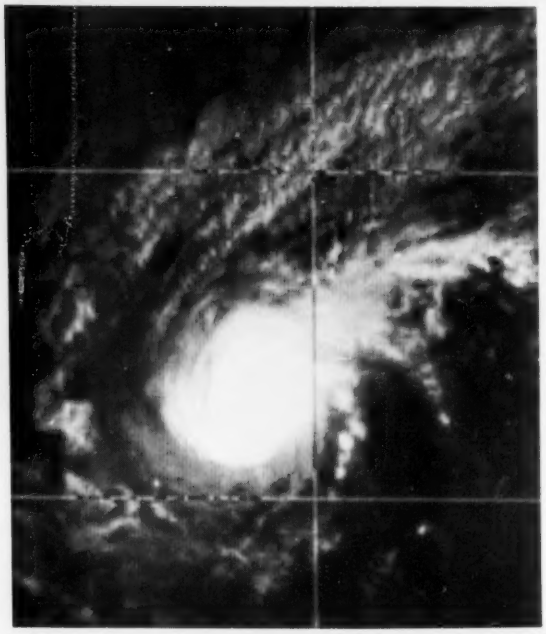


Figure 68.--New Year's baby Alice has quickly matured in a week by January 7.

dropped to tropical-storm strength the following day. By the 14th Alice was a weak depression southeast of Iwo Jima.

Casualties--The 26,024-ton Israeli ZIM HAIFA was in Hong Kong on the 4th with heavy-weather damage. The Panamanian bulkcarrier BEACONS (16,466 tons) was at Kawasaki on the 5th with heavy-weather damage to bulwarks and deck stanchions. The 700-ton ferry SHODOSHIMA MARU and the 196-ton freighter KYOEI MARU collided in fog on the Inland Sea on the 9th.

The U.S. deck barge ANTONE F. was reported in danger of sinking on the 8th about 150 mi southwest of Coos Bay, Oreg., after a cargo of grain shifted in heavy weather and the stern ballast tanks flooded. The 12,174-ton PAC MAJESTY encountered heavy weather enroute from the United States to Tomakomai. The No. 1 hold was flooded, and hatch pontoons were carried overboard.

The Liberian 10,239-ton MIDAS PRINCE, Vancouver to Kobe, with a cargo of grain encountered heavy weather and took shelter near Agattu Island on the 13th. On the 19th the 10,019-ton SEALANE TRADER, Vancouver to Kobe, reported heavy-weather damage sustained during December and January. The 12,187-ton ASIAN HAWK on a voyage from Port Angeles to Tokyo encountered heavy weather and diverted to Honolulu. They lost 70 logs and 4 hatch pontoons and received hull damage.

The 39,503-ton Liberian UNIVERSE CONVEYOR was due Kobe on the 21st with heavy-weather damage. The American 9,110-ton JOHN TYLER sailing for Nakhodka, Russia, reported on the 24th that 13 tractors broke loose from their lashings during heavy weather.

# Marine Weather Diary

## NORTH ATLANTIC, APRIL

WEATHER. During April, weather conditions over the middle and northern latitudes are generally much more settled compared to the preceding month. Thus, intervals of favorable weather are more frequent and usually of longer duration. There is a notable reduction in the frequency and intensity of winter-type LOWs. The 1007-mb Icelandic Low lies off Kap Farvel near 59°N, 41°W. The Azores High (1021 mb) is centered more than 1,700 mi farther south near 30°N.

WINDS. The prevailing wind north of 40°N is generally from the westerly quarter of the compass except over the Norwegian Sea, where winds are quite variable. Within this large belt, about 55 percent of the observations report winds of force 4 to 6. From about 40°N southward to the northern boundary of the trades, the prevailing wind is mostly southwesterly, although winds with an easterly component are prevalent off the east coast of Florida out to 70°W, and over the Gulf of Mexico. Near the coasts of Morocco and Portugal, northerly winds dominate, and westerly and northwesterly winds hold sway over the Mediterranean Sea. The winds north of the trades and south of the westerlies are weaker than their counterparts north of 40°N--only about 45 percent of all observations yield winds of force 4 to 6. The trades are more firmly entrenched in April, as compared to March. They usually prevail south of 25°N and, in the eastern North Atlantic, extend to about 30°N. Fifty to 75 percent of the time, they are force 3 to 4.

GALES. The area subject to gales decreases greatly in the middle and northern latitudes, compared to March. The most southern point of the 10-percent frequency boundary has moved northward to 53°N, 45°W. The area affected is enclosed by that point to 60°N, 15°W, to 62°N, 25°W, to 65°N, 28°W, to 63°N, 55°W, to 53°N, 45°W. A small area (about 6° square) of 10-percent frequency is centered east of the Grand Banks near 47°N, 38°W. Gales also spread over the Gulf of Lions about 10 percent of the time.

EXTRATROPICAL CYCLONES. Principal areas of cyclogenesis during the spring months (March, April, and May) are found in a broad area from Cape May down to Georgia on the United States east coast, eastnortheastward out to the central ocean, including the waters around Newfoundland. Within this region, cyclogenesis is concentrated from the coasts of Virginia and North Carolina northeastward to a point near 39°N, 66°W. Other principal areas of cyclogenesis lie around the south coast of Iceland; over most of the Baltic Sea, including Danish waters, but not including the Gulf of Bothnia; off Norway's arctic coast; over the Bay of Biscay; and over the Gulf of Genoa, the northern and central Adriatic Sea, and the southwestern Black Sea. Primary storm tracks in April are much the same as in March. One track begins about 250 mi east of Cape May and travels northeastward over the Grand Banks. The storms heading northeastward across the North Atlantic tend to pass a little farther south of Iceland than in March. Over the Mediterranean, the primary storm track reaches northern Italy, but does not extend to southern Turkey as it did in March.

TROPICAL CYCLONES have not been reported during April in the North Atlantic in the past 104 yr. This is the only month of the year in which no tropical storm activity has occurred.

SEA HEIGHTS of at least 12 ft are found more than 10 percent of the time north of a line extending from Labrador around the eastern margin of the Grand Banks to 41°N, 50°W, westward to 70°W. The same line curves eastward along the 36th parallel to 60°W, and then across the North Atlantic to Ireland and central Norway. Another small area of 10-percent frequency extends from the Gulf of Lions southeastward to a distance of 150 mi out over the Mediterranean. An elliptically shaped area of 20-percent frequency extends from latitude 55° to 60°N, and across longitudes 15° to 55°W.

VISIBILITY. Occurrences of low visibility increase over the western part of the North Atlantic, especially west of 40°W. The greatest change from March takes place over the Grand Banks and the waters south and east of Newfoundland, where over 20 percent of the observations show visibilities of less than 2 mi. Visibility over the Norwegian Sea has decreased in the west and increased in the east. The area of 10-percent frequency of low visibility over the North Sea has moved southwestward and extends from the tip of southern Norway to the coast of Great Britain.

## NORTH PACIFIC, APRIL

WEATHER. The weather over the North Pacific generally shows marked improvement over that of any month since October. Compared to the winter months, periods of storminess are fewer, but severe extratropical LOWs are still encountered occasionally. The Aleutian Low has filled to three 1009-mb centers along 55°N. Its configuration is that of a banana, bridging from the Gulf of Alaska to the Sea of Okhotsk. The 1012-mb isobar orientation has changed very little over the past months, except the southern boundary has moved steadily northward with spring, now approximating 50°N. The three LOWs are located just east of Kamchatka, in the middle of the Bering Sea, and in Bristol Bay. The Pacific High is expanding with two major centers near 32°N, 159°W, and 32°N, 178°W.

WINDS. Over about half of the North Pacific between 40° and 55°N, the windspeeds are of force 4 to 6 in 50 to 65 percent of the observations. The remainder of this latitudinal belt, especially near the coast of North America, experiences winds of force 3 to 5. The prevailing winds are from the westerly quarter. Between 30° and 40°N, winds are variable west of 170°E, mainly southwesterly between 170°E and 150°W, and westerly to northerly east of 150°W. Forces 3 to 5

are recorded in 45 to 70 percent of the observations. Variable force 5 winds often blow over the western half of the Bering Sea, and northerly force 5 winds are quite common over the eastern half. Easterly winds of about force 4 sweep over the northern Gulf of Alaska. South of Japan, easterly force 4 winds prevail, and winds from any direction except west and southwest are common over the East China Sea, where force 3 to 4 is the rule. The "northeast trades" prevail south of 25°N, over the western ocean between the dateline and the Philippines, and south to 30°N over eastern waters. The trades blow at about force 4, except near the Equator and over the Philippine Sea, where force 3 winds prevail. The northeast monsoon continues to dominate the South China Sea, but with less strength and steadiness than in the colder months. Winds of force 2 to 3 account for between 46 and 63 percent of all observations. Northerly winds continue to prevail south of the Gulf of Tehuantepec, but gales over the Gulf now occur less than 5 percent of the time. Force 2 to 3 winds are experienced 50 percent of the time, compared to 40 percent in March.

GALES. Two areas of high gale frequencies, 10 to almost 20 percent, persist as a residual of the winter month in the middle and northern latitudes. One holds sway over the Gulf of Alaska south of Kodiak Island to about 52°N, and eastward to near 140°W. The other is a belt 250 to 370 mi wide that lies east of Honshu from about 36°N, 147°E, northeastward to about 45° to 48°N, and 178°E.

EXTRATROPICAL CYCLONES. The principal area of cyclogenesis stretches from south of Kyushu northeastward to about 700 mi south of Beringa Island. A primary track from across Sakhalin Island combines with the one above and follows the Aleutian Islands into the Gulf of Alaska. About 180°, a branch shoots off to the northeast toward, and over, the Pribilof Islands. About midway between Hawaii and Adak, a track points northeastward toward Yakutat. A secondary cyclone path enters British Columbia near the southern tip of the Queen Charlotte Islands. The storm tracks have moved slightly northward over the western waters. The intensity of the storms has started to decrease, resulting in fewer gales.

TROPICAL CYCLONES. In an average 10-yr period, about seven tropical storms can be expected over Far Eastern waters. About 80 percent of these, or 4 out of 5, have developed to typhoon strength. Tropical cyclones develop in the same region as they did in March, east of the central and southern Philippines and west of 170°W, but the area affected by these warm-core storms has expanded northwestward to include the waters east of Luzon and around Taiwan. A tropical cyclone in the eastern North Pacific in April would be a rarity.

SEA HEIGHTS. The area where there is at least a 10-percent frequency of 12-ft, or higher, seas is roughly bounded by 155°E and 150°W on the west and east, 52°N on the north, 32°N on the southwest corner, and 45°N on the southeast. An area of 10-percent frequency of swells equal to, or greater than, 12 ft parallels the coastline of North America, including the Aleutian Islands, and joins the western half of the above area.

VISIBILITY. Reduced visibility (less than 2 mi) of 10-percent, or greater, frequency extends to the north of a line drawn from Sakhalin southeastward to about 40°N, 160°E, and then east-northeastward to about 45°N, 175°W. From there the line swings northward to Amlia Island in the eastern Aleutians, and then eastward to about 50°N, 150°W, before cutting back across the Alaska Peninsula to the Bering Sea, east of St. Lawrence Island. The area of 20-percent frequency has decreased in size since March and is now centered over the northern Kurils.

## NORTH ATLANTIC, MAY

WEATHER over the North Atlantic continues to moderate during May. The Azores High builds slightly to a central pressure of 1022 mb near 31°N, 40°W, while the Icelandic Low centered several hundred miles southeast of Greenland's southern tip fills to about 1012 mb.

WINDS over the greater part of the ocean between 40° and 55°N are generally westerly, except northeasterly over the Baltic Sea, but with less persistence than earlier in the spring. The average windspeed north of 40°N is force 4. Winds are quite variable between 55° and 60°N and are generally northerly north of 60°N. Between 25° and 40°N, winds are somewhat lighter, generally of force 3. West of 40°W, within the above latitudinal belt, south and southwest winds tend to prevail; while east of this longitude, winds from the northerly quarter of the compass are by far the most frequent of all. Over Mediterranean waters, west-northwesterly winds of force 2 to 3 are the most common. The Gulf of Mexico plays host to easterly force 3 winds. The "northeast trades," force 3 to 4, dominate the wind regime between 5° and 25°N, except along the African coast, where they extend northward to about 30°N. South of 5°N to the Equator, the force 2 to 3 winds almost always have an easterly component.

EXTRATROPICAL CYCLONES continue to develop frequently from off the Carolina coast northeastward to Newfoundland, but are becoming less severe. The direction of movement from Newfoundland is generally either north toward the Davis Strait, or northeast toward the Norwegian Sea. Two primary tracks affect the Great Lakes. One runs east-southeastward from Lake Winnipeg to south of James Bay. Another follows a line from eastern Iowa across southern Lake Michigan and southern Lake Huron to lower Quebec. After meeting, the two tracks proceed as one to the Gulf of St. Lawrence.

GALES are rare below 40°N, and their frequency and duration in higher latitudes are less than in the preceding months. The area of maximum likelihood of gales, 10 to 20 percent, generally is located from the southern tip of Greenland southward to about 52°N, between 40° and 56°W.

TROPICAL CYCLONES are infrequent during May. During the 44-yr period 1931-77, nine tropical storms have occurred, and two of them attained hurricane force.

SEA HEIGHTS of 12 ft or more are encountered from 5 to 10 percent of the time along the northern shipping lanes, from several hundred miles east of the Chesapeake Bay to the northern Norwegian coast, excluding the North Sea and the Bay of Biscay, but including the Gulf of Lions southeastward to Sardinia. The frequency increased to more than 10 percent in the midocean area and to more than 20 percent south of Kap Farvel.

VISIBILITY limited to less than 2 mi is encountered 10 to 20 percent of the time over the western North Atlantic, from about 40°N, 65°W, northeastward to a point near 53°N, 30°W, and then westward to the Labrador Sea. The line, north of which frequencies are greater than 10 percent, but less than 20 percent, then extends northeastward over Kap Farvel to north of Iceland, and through the Norwegian Sea to the Barents Sea. Visibility less than 2 mi also occurs between 10 and 20 percent of the time over a great part of the northeastern North Sea. Frequencies increase to over 20 percent of the time over the Grand Banks and off the southwest coast of Greenland.

## NORTH PACIFIC, MAY

WEATHER continues to improve slowly over the North Pacific in May. The subtropical High has an average central pressure of about 1022 mb and is located near 34°N, 152°W. The Aleutian Low becomes a broad weakening trough extending from the Asian mainland eastward to the western Gulf of Alaska. The lowest pressure, about 1008 mb, is centered over the west-central Bering Sea.

WINDS north of the 25th parallel tend to come from the westerly quarter of the compass, but variable winds are present over a number of locations on either side of the dateline. Winds over the Gulf of Alaska are easterly at force 3 to 4. Along the coast of the United States, northwesterly components are pronounced. Between the Equator and 25°N, (30°N, east of 180°), the "northeast trades" are very steady, except over the southern half of the South China Sea, where southerly winds of the southwest monsoon have established themselves. These monsoon winds are usually force 2 to 3, though lighter winds are not unusual. Over most of the rest of the North Pacific, windspeeds average force 3 or 4. Northerly and westerly winds prevail out from the Gulf of Tehuantepec, with easterly and northwesterly winds close behind. Speeds are force 2 or 3, 48 percent of the time.

EXTRATROPICAL CYCLONES continue to develop over the Ryukyus and then move east-northeastward toward the Gulf of Aiaska. A second primary storm track crosses the Siberian coast and Sakhalin, continues eastward across the northern Kuril Islands, and then curves toward the southern Bering Sea.

GALES decrease in frequency. In midocean between 40°N and the Aleutians, the chance of encountering gale-force winds remains slightly above 5 percent. Two smaller areas of similar frequency are found near the Alaska Peninsula and over the southern part of the Gulf of Alaska.

TROPICAL CYCLONES. Tropical storms occur, on the average, slightly more than once each year over the western ocean. There have been some years with none, but some with as many as four. Roughly 75 percent of these tropical storms become typhoons. The areas of most frequent development are south of 20°N, from the Carolines westward across the Philippines and the South China Sea. About once every 2 yr, a tropical storm or hurricane develops over the ocean area off Mexico during May.

SEA HEIGHTS. Seas of 12 ft or more continue to decrease in frequency as the winds decrease. The area of 10 percent or greater has the shape of a long balloon squeezed in the middle. The northern boundary parallels the Aleutian Islands about 400 mi to the south, between 160°E and 148°W. The southern boundary is 40°N over the western, and 45°N over the eastern ocean. High swells continue to be observed off the Asian and northern coasts, with a larger area in midocean very roughly bounded by 30° and 50°N, 155°E and 170°W.

VISIBILITY less than 2 mi occurs more than 10 percent of the time over the western North Pacific Ocean north of 35°N, and over the eastern North Pacific Ocean north of 42°N and west of 140°W, excluding the Gulf of Alaska and the waters southeast of the central Aleutians. Over the northern Kurils, this low visibility occurs more than 30 percent of the time.

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NOAA National Weather Service Port Meteorological Offices have personnel who visit ships in port to check and calibrate barometers and other meteorological instruments. In addition, port meteorologists assist masters and mates with problems regarding weather observations, preparation of weather maps, and forecasts. Meteorological manuals, forms, and some instruments are also provided.

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